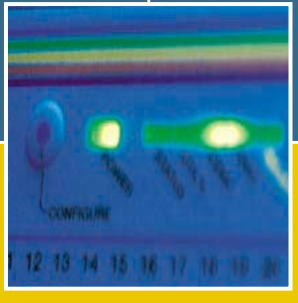
AR400 SERIES ROUTER

USER GUIDE



Allied Telesyn
Simply connecting the IP world

Software Release 2.4.1

AR400 Series User Guide for Software Release 2.4.1
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Chapter 1

Introduction

Introducing The AR400 Series Router

Congratulations on purchasing an AR400 Series router — the optimal solution for your small or medium sized business.

This guide introduces the AR400 Series router and will guide you through the most common uses and applications of your new router. Getting started will not take long—many applications are set up in just a few minutes. If you have any questions about the router, contact your authorised distributor or reseller.

Why Read This User Guide?

Before you use your router in a live network, please read this guide. The guide tells you how to access and use the Command Line Interface (CLI) to configure the router software. For more detailed descriptions of all commands and display outputs see the *AR400 Series Router Software Reference*.

This user guide is organised into the following chapters:

- *Chapter 1, Introduction* gives an overview of the router features and of the documentation supplied with your router.
- *Chapter 2, Getting Started* describes how to gain access to the command line interface.
- *Chapter 3, Operating the Router* introduces general operation, management and support features, including loading and installing support files and new releases.
- *Chapter 4, Physical and Layer 2 Interfaces* describes how to configure Layer 2 switching features, including switch ports and VLANs.
- *Chapter 5, Routing* describes how to configure routing over VLANs and other Layer 3 interfaces.
- *Chapter 6, Maintenance and Troubleshooting* describes some of the commands you can use to monitor the router and diagnose faults.

Where To Find More Information

Before installing the router and any expansion options, read the important safety information in the *AR400 Series Router Safety and Statutory Information* booklet.

Follow the *Quick Install Guides'* step-by-step instructions for physically installing the router and any expansion options.

The *AR Series Router Hardware Reference* gives detailed information about the equipment hardware.

Once you are familiar with the basic operations of the router, use the *AR400 Series Router Software Reference* for full descriptions of routing features and command syntax.

The AR400 Series Router Documentation Set

The documentation set for the AR400 Series router includes:

- AR400 Series Router Safety and Statutory Information
- AR400 Series Router Quick Install Guide
- AR400 Series Router Documentation and Tools CD-ROM

  The AR Series Router Documentation Set in Adobe Acrobat PDF format—the complete reference to installing, configuring and managing the router, including detailed descriptions of all commands. The CD-ROM includes the following PDF documents for the AR410:

  - AR400 Series Router Safety and Statutory Information
  - AR400 Series Router Quick Install Guide
  - AR Series Router Hardware Reference
  - AR400 Series Router Software Reference
  - Port Interface Card Quick Install Guide
  - Port Interface Card Hardware Reference

The CD-ROM, bundled with every router, also includes:

- Application Notes—a collection of technical and background papers on the application of AR router technologies.
- Configuration Examples—a collection of ready-to-use examples of typical network configurations, complete with scripts to download to an AR AR router using AT-TFTP.
- AT-TFTP Server for Windows, for downloading software releases, scripts and other files to or from an AR router.
- Adobe Acrobat Reader for Windows for viewing and printing the online documentation in PDF format. Get instant access to information with full-text searching of PDF documents by keyword or phrase.
- Microsoft Internet Explorer and Netscape Communicator.
- Demonstration versions of networking utilities, such as AR-Remote File Manager (AR-RFM) from Allied Telesyn and F-Secure's Secure Shell client for Windows.
- Information about other Allied Telesyn routing and switching products.

Online Technical Support

For online support for your AR400 Series router, see our online support page at http://www.alliedtelesyn.co.nz/support/ar400.

This page also contains the latest router software release. Use the LOAD command to download software upgrades directly from the Allied Telesyn web site to the router's FLASH memory. Use the SET INSTALL command to enable the new software release (see "*Upgrading Router Software*" on page 34).

If you require further assistance, contact your authorised distributor or reseller.

Features of the AR400 Series Router

The AR400 Series router supports a wide range of network interfaces which allows you to choose the network service that is right for you. The base unit supports:

- four 10/100 Mbps full duplex switched Ethernet LAN ports.
- one 10/100 Mbps full duplex Ethernet WAN port
- one asynchronous serial port
- one Port Interface Card (PIC) Bay
- one internal MAC slot

You can add additional interfaces to your AR400 Series router by installing a Port Interface Card (PIC) in the PIC bay.

The software support for the AR400 Series router and the expansion options provides wirespeed Layer 2 switching, including support for Virtual LANs. In addition, the router provides a wide array of multiprotocol routing, security and network management features.

Management Features

The following features enhance management of the router:

- A sophisticated and configurable event logging facility for monitoring and alarm notification to single or multiple management centres.
- Triggers for automatic and timed execution of commands in response to events.
- Scripting for automated configuration and centralised management of configurations.
- Dynamic Host Configuration Protocol (DHCP) for automatically assigning IP addresses and other configuration information to PCs and other hosts on TCP/IP networks.
- Telnet client and server.
- An HTTP client that allows the direct download of files from a web server to the router's FLASH memory.

For complete descriptions of these software features, see the *AR400 Series Router Software Reference*.

Software Features

Existing Software features for the AR400 Series router include:

- IP, IPX and AppleTalk routing
- IPv6
- OSPF
- RIP and RIP V2
- Spanning tree bridging
- BAP/BACP (Bandwidth Allocation Protocol)
- PPP multilink
- CLI, PAP and CHAP
- Callback
- RADIUS
- VRRP
- BGP-4
- PPPoE
- SNMP management
- Firewall
- IPSec
- Frame Relay
- X.25
- Secure Shell remote management
- RSVP
- L2TP (Layer 2 Tunnelling Protocol)
- DHCP
- Generic Routing Encapsulation (GRE)
- ISDN
- Dynamic IP address assignment
- IP packet filtering
- IP multihoming
- Demand IP and IPX
- IPX/SPX spoofing
- IP/IPX and bridge filtering
- IP packet Prioritisation
- 56-bit & 3DES encryption option
- Secure VPN option
- STAC data compression
- Network Address Translation (NAT)

Special Features Licences

You need a special feature licence and password to activate some special features over and above the standard software release. Typically, these special features are covered by government security regulations. Special feature licences and passwords are quite separate and distinct from the standard software release licences and passwords. Some of the software features that require a special features licence are:

- Triple DES S/W
- Firewall SW
- Firewall SMTP Application Gateway
- Firewall HTTP Application Gateway
- Secure Shell
- DES encryption
- Public Key Infrastructure
- IP Multicast Routing (PIM, DVMRP)
- IPv6

For information on how to enable special feature licences see "*Enabling Special Feature Licences*" on page 19.

Chapter 2

Getting Started

This Chapter

Your AR400 Series router is supplied with default settings which allow you to operate the router immediately, without any configuration. Even if this is all you want to do, you should still gain access to the router configuration, if only to change the *manager* password to prevent unauthorised access.

To change the switching configuration, and to take advantage of the advanced routing features, you will need to enter detailed configuration. The router has a Command Line Interface (CLI) for configuration and management.

This chapter describes how to get started using the CLI to configure the router, including:

- Physically connect a terminal or PC to the router (see "*Connecting a Terminal or PC*" on page 14 and the *AR400 Series Router Quick Install Guide).*
- Set the Terminal Communication parameters to match the router's settings (see "*Terminal Communication Parameters*" on page 15).
- Log in to the router as a manager (see "*Logging In*" on page 15).
- Change the management password to limit unauthorised access to the router configuration (see "*Changing a Password*" on page 16).
- Use the command line interface to control the router software, including creating aliases for often used character sequences (see "*Using the Commands*" on page 17).
- Set the online help file to gain access to command syntax help (see "*Getting Command Line Help*" on page 18).
- Enable any special feature licences (see "*Enabling Special Feature Licences*" on page 19).
- Set the name, location and contact details for the router (see "*Setting System Parameters*" on page 19).
- Configure IP addresses on the router interfaces over which you will manage the router. This is necessary if you will access the router using Telnet (see "*Assigning an IP Address*" on page 20).
- Set routes (see"*Setting Routes*" on page 21)

Warning about FLASH memory

Before you start to configure your router, note that it is possible to enter commands that can impact severely on your router's performance.

DO NOT clear the FLASH memory completely. The software release files are stored in FLASH, and clearing FLASH memory would leave no software to run the router.

While FLASH is compacting, do not restart the router or use any commands that affect the FLASH file subsystem. Do not restart the router, or create, edit, load, rename or delete any files until a message confirms that FLASH file compaction is completed. Interrupting flash compaction may result in damage to files. Damaged files are likely to prevent the router from operating correctly.

For more information, see "*How to Avoid Problems*" on page 89 and "*What to do if you clear FLASH memory completely*" on page 90.

Connecting a Terminal or PC

The first thing to do after physically installing the router is to start a terminal session to access the router. Then you can use the command line interface (CLI) to configure the router.

You can use a PC running terminal emulation software as the manager console instead of a terminal. Many terminal emulation applications are available for the PC, but the most readily available are the HyperTerminal application included in Microsoft® Windows™ 95, Windows™ 98, and Windows™ 2000. In a normal Windows™ installation HyperTerminal is located in the Accessories group. In Windows™ 2000, HyperTerminal is located in the Start > Programs > Accessories > Communications menu.

The key to successfully using terminal emulation software with the router is to configure the communications parameters in the terminal emulation software to match the default settings of the console port on the router. For instructions on how to configure HyperTerminal, see the *AR Series Router Hardware Reference*.

To start a terminal session, connect to the router in one of the following ways:

- Connect a VT100-compatible terminal to the RS-232 Terminal Port, set the communications parameters on the terminal (Table 1 on page 15), and press [Enter] a few times until the router's login prompt appears; *OR*
- Connect the COM port of a PC running terminal emulation software such as Windows Terminal or HyperTerminal to the RS-232 Terminal Port, set the communications parameters on the terminal emulation software (Table 1 on page 15), and press [Enter] a few times until the router's login prompt appears.

Terminal Communication Parameters

Check that the terminal or modem's communication settings match the settings of the asynchronous port. By default, the asynchronous port (also known as the Console, RS-232, or Config port) on the router is set to the parameters shown in Table 1 on page 15:

Table 1: Parameters for terminal communication

Parameter	Value
Baud rate	9600
Data bits	8
Parity	None
Stop bits	1
Flow control	Hardware

Refer to the user manual supplied with the terminal or modem for details of how to change the communications settings for the terminal or modem.

If a modem is connected, configure the router to make and/or accept calls via the modem. To set the CDCONTROL parameter to "CONNECT" and the FLOW parameter to "HARDWARE", enter the command:

```
SET ASYN CDCONTROL=CONNECT FLOW=HARDWARE
```

If the terminal or modem is used with communications settings other than the default settings, then configure the asynchronous port to match the terminal or modem settings using the SET ASYN command.

See the router's online help or the *Interfaces* chapter in the *AR400 Series Router Software Reference* for more information on how to configure the asynchronous port.

Logging In

When you access the router from a terminal or PC connected to the RS-232 terminal port (asyn0), or via a Telnet connection, you must enter a login name and password to gain access to the command prompt. When the router is supplied, it has a *manager* account with an initial password *friend*.

Enter your login name at the login prompt:

```
login: manager
```

Enter the password at the password prompt:

```
password: friend
```

Changing a Password

You should change this password to prevent unauthorised access to the router. Enter the command:

```
SET PASSWORD
```

The router prompts you for the current password, for the new password, and for confirmation of the new password. The password can contain any printable characters, and must be at least a minimum length, by default six characters. (To change the default minimum length, see the SET USER command in the *Operations* chapter, *AR400 Series Router Software Reference*.)

Choosing a Password

All users, including managers, should take care in selecting passwords. Tools exist that enable hackers to guess or test many combinations of login names and passwords easily. The User Authentication Facility (UAF) provides some protection against such attacks by allowing the manager to set the number of consecutive login failures allowed and a lockout period when the limit is exceeded.

However, the best protection against password discovery is to select a good password and keep it secret. When choosing a password:

- Do make it six or more characters in length. The UAF enforces a minimum password length, which the manager can change. The default is six characters.
- Do include both alphabetic (a–z) and numeric (0–9) characters.
- Do include both uppercase and lowercase characters. The passwords stored by the router are case-sensitive, so “bgz4kal” and “Bgz4Kal” are different.
- Do avoid words found in a dictionary, unless combined with other random alphabetic and numeric characters.
- **Do not** use the login name, or the word “password” as the password.
- **Do not** use your name, your mother’s name, your spouse’s name, your pet’s name, or the name of your favourite cologne, actor, food or song.
- **Do not** use your birth date, street number or telephone number.
- **Do not** write down your password anywhere.

Make sure you remember the new password created as you cannot retrieve a lost password. Recovery of access to the router is complex.

Once you have logged into the *manager* account you are able to enter commands from this guide and from the *AR400 Series Router Software Reference*.

Using the Commands

You control the router with commands described in this document and in the *AR400 Series Router Software Reference*. While the keywords in commands are not case sensitive, the values entered for some parameters are. The router supports command line editing and recall. Command line editing functions and keystrokes are shown in Table 2 on page 17.

Table 2: Command line editing functions and keystrokes.

Function	VT100 Terminal	Dumb terminal
Move cursor within command line	←, →	*Not available*
Delete character to left of cursor	[Delete] or [Backspace]	[Delete] or [Backspace]
Toggle between insert/overstrike	[Ctrl/O]	*Not available*
Clear command line	[Ctrl/U]	[Ctrl/U]
Recall previous command	↑ or [Ctrl/B]	[Ctrl/B]
Recall next command	↓ or [Ctrl/F]	[Ctrl/F]
Display command history	[Ctrl/C] or SHOW PORT HISTORY	[Ctrl/C] or SHOW PORT HISTORY
Clear command history	RESET PORT HISTORY	RESET PORT HISTORY
Recall matching command	[Tab] or [Ctrl/I]	[Tab] or [Ctrl/I]

The router assumes that the width of the terminal screen is 80 characters, and performs command line wrapping at the 80th column regardless of the setting of the terminal. To execute a command the cursor does not need to be at the end of the line. The default editing mode is insert mode. Characters are inserted at the cursor position and any characters to the right of the cursor are pushed to the right to make room. In overstrike mode, characters are inserted at the cursor position and replace any existing characters.

Commands run from the command line are limited to 128 characters, including the prompt. If a command is longer than 128 characters, split the command in two, for example, by following an ADD command with a SET command.

Aliases

The command line interface supports aliases. An alias is a short name for an often-used longer character sequence. When the user presses [Enter] to execute the command line, the command processor first checks the command line for aliases and substitutes the replacement text. The command line is then parsed and processed normally. Alias substitution is not recursive—the command line is scanned only once for aliases.

Aliases are created and destroyed using the commands:

```
ADD ALIAS=name STRING=substitution
DELETE ALIAS=name
```

Getting Command Line Help

Online help is available for all router commands. A multilingual, language-independent online help facility provides help information via the command:

```
HELP [topic]
```

If a topic is not specified, a list of available topics is displayed. The HELP command displays information from the system help file stored in FLASH memory. The help file uses a simple mark-up language to identify topics, access level (USER or MANAGER) and help text. Both standard ASCII and Unicode character encodings are supported. Alternate help files can be uploaded and stored in FLASH, then activated using the command:

```
SET HELP=helpfile
```

To display the current help file, enter the command:

```
SHOW SYSTEM
```

The help file is easily modified, for example to provide detailed site-specific support information. The mark-up language specification and preprocessor program are available from your authorised distributor or reseller.

Also, typing a question mark "?" at the end of a partially completed command displays a list of the parameters that may follow the current command line, with the minimum abbreviations in uppercase letters (see Figure 1 on page 18). The current command line is then re-displayed, ready for further input.

Figure 1: Using the question mark character ("?") to display help for the current command.

```
Manager > ADD ?

  Options : ACC APPletalk BGP CLASSifier BOOTp BRIDge DECnet FRamerelay GRE IP IPX
    ISDN LAPD LOG MIOX NTP OSPF PERM PPP QOS RADius SA SCript SNmp STReam STT TRIGger
    TACacs USEr X25C X25T TDM

Manager > ADD ACC ?

  Options : CALL SCript DOmainname

Manager > ADD ACC CALL ?

  Options : DIrection DScript CScript RScript POrt ENcapsulation AUthentication
    DOmainname
```

Enabling Special Feature Licences

You must enable the special feature licence you have purchased before you can use the licenced features. You will need the password provided by your authorised distributor or reseller. The advanced upgrade licence and password are different from the standard software release licence and password. The licence cannot be transferred from one router to another.

For software features that require a special feature licence see "*Special Features Licences*" on page 11.

You must order passwords for special feature licences from your authorised distributor or reseller. You must specify the special features that require a licence and the serial number(s) of the router(s) on which the special feature licences are to be enabled.

The password for a special feature licence is a string of at least 16 hexadecimal characters. This password encodes the special feature, or features, covered by the license, and the router serial number. The password information is stored in the router's FLASH memory.

To enable or disable a special feature licence, enter the commands:

```
ENABLE FEATURE=feature PASSWORD=password
DISABLE FEATURE=feature
```

To list the current special feature licences, enter the command:

```
SHOW FEATURE[={featurename|index}]
```

Setting System Parameters

You can set some general system parameters to ensure the router's compatibility with the public network, and to aid network administration.

Some services, for instance ISDN, use slightly different versions in different countries. To make sure that the router uses protocols consistent with the services it is connected to, set the system territory to the country or region in which your router operates. Enter the command:

```
SET SYSTEM TERRITORY={AUSTRALIA|CHINA|EUROPE|JAPAN|KOREA|
    NEWZEALAND|USA}
```

In Australia only: to use the Micro service, SET SYSTEM LOCATION=australia; to use the OnRamp service, SET SYSTEM LOCATION=europe.

System name, location and contact parameters can help a remote network administrator identify the router. By convention the system name is the full domain name. Set the name of the router, for example:

```
SET SYSTEM NAME=nd1.co.nz
```

the location of the router, for example:

```
SET SYSTEM LOCATION="Head Office, 3rd floor east"
```

and a contact name and phone number for the network administrator responsible for the router, for example:

```
SET SYSTEM CONTACT="Anna Brown 03-456 789"
```

The name, location, and contact are strings 1 to 80 characters in length of any printable character. If the string includes spaces enclose the string in double quotes.

Set the router's real time clock to the current local time in 24 hour notation (hh:mm:ss), for example:

```
SET TIME=14:50:00
```

and to the current date (dd-mmm-yy, or dd-mmm-yyyy), for example:

```
SET DATE=29-JAN-02
```

or

```
SET DATE=29-JAN-2003
```

Assigning an IP Address

After you log into the manager account (see "*Logging In*" on page 15) you can enter commands from this document and from the *AR400 Series Router Software Reference*.

You may want access to the router over one of its switch ports (also called network ports) in order to Telnet into the router from an IP host connected to one of the switch ports.

Firstly, to enable IP, enter the command:

```
ENABLE IP
```

Then, to add an IP interface over the default VLAN (vlan1) and assign it an IP address (e.g. 192.168.1.1), enter the command:

```
ADD IP INTERFACE=vlan1 IPADDRESS=192.168.1.1
```

Once the router is configured with an IP address, you can access the command line interface by using Telnet to the router from an IP host connected to port 1 or 2.

Similarly, to give an IP address to other interfaces on the router, including the the DMZ VLAN containing port 3 (vlan2), the WAN Ethernet port (eth0), or other interfaces added to the PIC bay, enter the command:

```
ADD IP INTERFACE=interface IPADDRESS=ipadd
```

To change the IP address for an interface, enter the command:

```
SET IP INTERFACE=interface IPADDRESS=ipadd MASK=ipadd
```

To configure an IP interface to use an address assigned by the Dynamic Host Configuration Protocol (DHCP), and set the IPADDRESS parameter of the interface to DHCP, enter the command:

```
SET IP INTERFACE=interface IPADDRESS=DHCP
```

You do not need to set the MASK parameter because the subnet mask received from the DHCP server is used.

When you are configuring the router remotely, if you change the configuration, for instance the VLAN membership, of the port over which you are configuring, the router is likely to break the connection.

For more information about switch ports and Virtual LANs (VLANs), see *Chapter 4, Physical and Layer 2 Interfaces* in this document, and the *Switching* chapter in the *AR400 Series Router Software Reference.*

For more information about IP addressing and routing, see *Chapter 5, Routing* in this document, and the *Internet Protocol (IP)* chapter in the *AR400 Series Router Software Reference.*

Setting Routes

The process of routing packets consists of selectively forwarding data packets from one network to another. Your router makes a decision to send a packet to a particular network on information it learns dynamically from listening to the selected route protocol and on the static information entered as part of the configuration process. In addition, you can configure user-defined filters to restrict the way packets are sent.

Your router maintains a table of routes which holds information about routes to destinations. The route table tells the router how to find a remote network or host. A route is uniquely identified by IP address, network mask, next hop, ifIndex, protocol and policy. A list of routes comprises all the different routes to a destination. The routes may have different metrics, next hops, policy or protocol. A list of routes is uniquely identified by its IP address and net mask.

The routing table is maintained dynamically by using one or more routing protocols such as RIP, EGP and OSPF. These act to exchange routing information with other routers or hosts.

You can also add static routes to the route table to define default routes to external routers or networks and to define subnets.

To add a static route, enter the command:

```
ADD IP ROUTE=ipadd INTERFACE=interface NEXTHOP=ipadd
   [CIRCUIT=miox-circuit] [DLCI=dlci]
   [MASK=ipadd][METRIC=1..16] [METRIC1=1..16]
   [METRIC2=1..65535][POLICY=0..7] [PREFERENCE=0..65535]
```

To displays the entire routing table, including both static and dynamic routes, enter the command:

```
SHOW IP ROUTE
```

For more information about setting IP routes, see the *Internet Protocol (IP)* chapter in the *AR400 Series Router Software Reference.*

Chapter 3

Operating the Router

This Chapter

This chapter introduces basic operations on the router, including:

- "*User Accounts and Privileges*" on page 23
- "*Normal Mode and Security Mode*" on page 25
- "*Remote Management*" on page 27
- "*Storing Files in FLASH Memory*" on page 27
- "*Using Scripts*" on page 28
- "*Loading and Uploading Files*" on page 30
- "*Upgrading Router Software*" on page 34
- "*Using the Built-in Editor*" on page 38
- "*SNMP and MIBs*" on page 38

User Accounts and Privileges

The router software supports three levels of privilege for users: USER, MANAGER, and SECURITY OFFICER. By default, the router has one account (*manager*) defined with manager privilege and the default password *friend*. The commands that a user can execute depends on the user's privilege level and whether the router is operating in normal or security mode (see "*Normal Mode and Security Mode*" on page 25). A USER level prompt looks like:

```
>
```

while a MANAGER prompt looks like:

```
Manager >
```

and a SECURITY OFFICER prompt looks like:

```
SecOff >
```

The MANAGER level has access to the full set of commands when the router is in normal mode. When the router is operating in security mode, users with MANAGER privilege cannot execute a subset of the commands known as the security commands (see "*Normal Mode and Security Mode*" on page 25).

In normal mode, a user with manager privilege can create and delete accounts for users with any of these privilege levels. Users and passwords are managed by the User Authentication Facility. Users and passwords are authenticated

using an internal database called the *User Authentication Database*, or by interrogation of external RADIUS (*Remote Authentication Dial In User Service*) or TACACS (*Terminal Access Controller Access System*) servers.

To use an account with manager privilege, log in to the account by entering the command:

```
LOGIN
```

The router prompts you to enter a user name and password. To return to USER mode, enter the command:

```
LOGOFF
```

Make sure that you do not leave a manager session unattended. Unauthorised use of a manager session gives access to the User Authentication Database. To reduce the risk of unauthorised activity, a subset of manager commands, called the security commands, have a security timer. These are shown are shown in Table 3 on page 24. When a security command is entered from a manager session, the security timer is started and is then restarted each time an additional security command is entered. If a security command is entered after the timer has expired, the manager is prompted to re-enter the password correctly before the command is actioned. The secure delay timer is by default 60 seconds. If the password is not entered correctly the password prompt is repeated a set number of times. If the correct password is still not entered a log message is generated and the session is logged off.

The security timer enables a manager to make successive additions and modifications to the database at one time without having to re-enter the password for every command.

The security timer does not provide a foolproof security mechanism. Managers should always attempt to log out of a manager session before leaving a terminal unattended.

Table 3: Secure commands controlled by the security timer.

Command	Description
ADD TACACS SERVER	Adds a TACACS server to the list of TACACS servers used for user authentication.
ADD USER	Adds a user to the User Authentication Database.
DELETE TACACS SERVER	Deletes a TACACS server from the list of TACACS servers used for user authentication.
DELETE USER	Deletes a user from the User Authentication Database.
PURGE USER	Deletes all users except MANAGER from the User Authentication Database.
SET MANAGER PORT	Assigns a port semipermanent MANAGER privilege.
SET USER	Modifies a user record in the User Authentication Database.

If the router is operating in security mode, the manager must also log in to a user account with SECURITY OFFICER privilege in order to execute any of the commands listed in Table 3 on page 24.

For more information about managing and using accounts with user, manager and security officer privileges, for a full list of security commands, and for information about enabling a *remote security officer*, see the *Operations* chapter in the *AR400 Series Router Software Reference*.

Normal Mode and Security Mode

The router operates in one of two modes, either normal mode or security mode. By default, the router is in normal mode.

When the router is in security mode, the command SHOW DEBUG does not display output of the SHOW FEATURE and SHOW CONFIGURATION DYNAMIC commands, or the current configuration in the SHOW SYSTEM output unless the SHOW DEBUG command is entered by a user with security officer privilege

If you wish to use the following software features you need to enable security mode:

- IP authentication
- Secure Shell (see the *Secure Shell* chapter, *AR400 Series Router Software Reference*)
- Encryption (see the *Compression and Encryption Services* chapter, *AR400 Series Router Software Reference*)
- IPsec (see the *IP Security* chapter, *AR400 Series Router Software Reference*)
- Public Key Encryption (PKI) (see the *Public Key Infrastructure* chapter, *AR400 Series Router Software Reference*)

To enable security mode, enter the command:

```
ENABLE SYSTEM SECURITY_MODE
```

When the router restarts, it restarts in the same normal mode or security mode as it was before restarting. To restore the router to normal operating mode, enter the command:

```
DISABLE SYSTEM SECURITY_MODE
```

When security mode is disabled, the router automatically deletes all sensitive data files, including encryption keys.

To display the current operating mode, enter the command:

```
SHOW SYSTEM
```

When the router is in security mode, a user with security officer privilege is the only person who can execute commands which affect router security. Table 4 on page 26 lists commands that only a security officer can execute when the router is in security mode. A complete list of commands limited by security mode are listed in the *Operation* chapter in the *AR400 Series Router Software Reference*.

Table 4: Commands requiring SECURITY OFFICER privilege when the router is operating in security mode.

Command	Specific Parameters
ACTIVATE SCR	
ADD IP INT	
ADD SCR	
ADD USER	
CREATE CONFIG	
CREATE PPP	
CREATE SNMP COMMUNITY	
DELETE FILE	
DELETE SCR	
DELETE USER	
DISABLE FEATURE	
DISABLE USER	
DUMP	
EDIT	
ENABLE FEATURE	
ENABLE SNMP	
ENABLE USER	
LOAD	
MAIL	
MODIFY	
PURGE USER	
RENAME FILE	
RESET USER	
SET CONFIG	
SET INSTALL	
SET IP INT	
SET SNMP COMMUNITY	
SET USER	
SHOW CONFIG	
SHOW FEATURE	
SHOW FILE	
SHOW PPP	CONFIG
UPLOAD	

Remote Management

You can manage remote routers as easily as you manage the local router a terminal is connected to. From a terminal connected to any port (with either USER or MANAGER privilege), enter the command:

```
TELNET ipadd
```

to Telnet to the remote router, specifying the remote router's IP address.

For information about how to set routes and on how you assign an IP address to your router, see "*Setting Routes*" on page 21 and "*Assigning an IP Address*" on page 20.

If the connection is successful, a login prompt from the remote router is displayed. Login using a login name that has been defined with MANAGER privilege (such as the default MANAGER login name), and enter the password.

To return to the local router and terminate the connection, enter the command:

```
LOGOFF
```

For more information about using Telnet, see the *Terminal Server* chapter in the *AR400 Series Router Software Reference*.

Storing Files in FLASH Memory

When you purchase the router, the router software release, the online help files, and a default configuration file are stored in FLASH memory, where they are saved even if the router is powered down. You will use the FLASH memory to store updated software releases or patches, and files that record the router's configuration.

The router also has Random Access Memory (RAM). The router software uses RAM to run the router. When you enter commands to configure the router these commands affect the dynamic configuration in RAM.

FLASH memory is like a flat file system, with no subdirectories, containing files with a filename up to eight characters long, and a three character extension (see Table 5 on page 30). You can save, list, rename and delete files in FLASH.

To display the files in FLASH, enter the command:

```
SHOW FILE
```

Figure 2: Example output from the SHOW FILE command.

```
Filename           Device        Size     Created                 Locks
-------------------------------------------------------------------------
1mac.scp           flash         527      08-Nov-2000 12:46:00    0
86s-210.rez        flash         1690736  14-Sep-2000 14:11:56    0
config.scp         flash         64       10-Nov-2000 23:26:31    0
hdroute.scp        flash         374      08-Nov-2000 12:46:00    0
loadup.scp         flash         173      20-Nov-2000 07:03:30    0
loadup1.scp        flash         224      14-Nov-2000 14:11:56    0
quick.scp          flash         2036     08-Nov-2000 12:46:00    0
release.lic        flash         32       08-Nov-2000 12:46:00    0
sleep.scp          flash         189      08-Nov-2000 12:46:00    0
test.cfg           flash         1698     09-Nov-2000 10:39:42    0
-------------------------------------------------------------------------
```

The Locks field indicates the number of concurrent software processes using the file.

The router automatically compacts FLASH memory when a maximum threshold of deleted files is reached. Compaction frees space for new files by discarding garbage. A message will appear when FLASH compaction is activated. Another message appears when FLASH compaction is complete.

While FLASH is compacting, do not restart the router or use any commands that affect the FLASH file subsystem. Do not restart the router, or create, edit, load, rename or delete any files until a message confirms that FLASH file compaction is completed. Interrupting flash compaction may result in damage to files.

Using Scripts

When you start or restart the router, or when it automatically restarts, it executes the configuration commands in the boot script. A boot script is a text file containing a sequence of standard commands that the router executes at startup. The default boot script is called `boot.cfg`. Commands run from a boot script are limited to 128 characters.

The commands you enter into the router from the command line affect only the dynamic configuration in RAM, which is not retained over a power cycle. The router does not automatically store these changes in FLASH memory. When the router is restarted, it loads the configuration defined by the boot script, or if the router was restarted using the RESTART command, any script file specified in the RESTART command.

In addition to the boot configuration script that the router automatically runs when it restarts, you can run a configuration script manually at any time, by entering the command:

```
ACTIVATE SCRIPT=filename
```

You can also set a trigger to automatically execute a configuration script when a specified event occurs.

For more information about how to create and run scripts, see the *Scripting* chapter in the *AR400 Series Router Software Reference*.

For information about creating triggers, see the *Trigger Facility* chapter in the *AR400 Series Router Software Reference.*

Saving the Router's Configuration

To view the router's current dynamic configuration, enter the command:

```
SHOW CONFIGURATION DYNAMIC
```

To save any changes made to the dynamic configuration after the router last restarted (booted) across a restart or power cycle, and save the modified configuration as a script file, enter the command:

```
CREATE CONFIG=filename.scp
```

To set the router to execute this script file when it restarts, enter the command:

```
SET CONFIG=filename.scp
```

The configuration file created by CREATE CONFIG command records passwords in encrypted form, not in cleartext.

You can create a script file from any of the router software commands. These are the same commands that are used to change the router's configuration dynamically. Manually edit a configuration file using the router's built in editor (see "*Using the Built-in Editor*" on page 38), or upload it to a PC using the UPLOAD command (see the *Operation* chapter, *AR400 Series Router Software Reference)*, edit it using any text editor, and download it again. Give configuration script files an extension of `.scp` or `.cfg`.

To display the name of the configuration file that is set to execute when the router restarts, enter the command:

```
SHOW CONFIG=filename
```

Storing Multiple Scripts

You can store multiple configuration scripts on the router. This allows you to test new configuration scripts once, before setting them as the default configuration. For example, to test the new configuration script `test.cfg`, enter the command:

```
RESTART ROUTER CONFIG=test.cfg
```

Storing multiple scripts also allows you to keep a backup router with configuration scripts stored on it for every router in the network to speed up network recovery time.

Loading and Uploading Files

When you want to upgrade your router to a new software patch or release, or use a new configuration file, load files onto the router using the router's LOADER module. You can also use the LOADER module to upload files, such as configuration files or log files, from the router onto a host on the network.

File Naming Conventions

The file subsystem provides a flat file system—directories are not supported. Files are uniquely identified by a file name of the form:

```
[device:]filename.ext
```

where:

- *device* specifies the physical memory device on which the file is stored, FLASH. If *device* is specified, it must be separated from the rest of the file name by a colon (":"). If *device* is not specified, the default is FLASH.
- *filename* is a descriptive name for the file, and may be one to eight characters in length. Valid characters are lowercase letters (a–z), uppercase letters (A–Z), digits (0–9) and the hyphen character (-).
- *ext* is a file name extension, one to three characters in length. Some file name extensions are shown in Figure 5 on page 30. Valid characters are lowercase letters (a–z), uppercase letters (A–Z), digits (0–9) and the hyphen character (-). The extension is used by the router to determine the data type of the file and how to use the file (Table 5 on page 30). If *ext* is specified, it must be separated from the *filename* portion by a period (".")

Table 5: File extensions and file types.

Extension	File type/function
CER	Public Key Infrastructure (PKI) certificate file.
FBR	Flash Boot software Release.
CFG	Configuration or boot script.
CRL	PKI Certificate Revocation List file.
CSR	PKI Certificate Signing Request file.
GIF	(Graphics Interchange Format) graphic image file.
HLP	CLI help file.
HTM	HTML file used by the HTTP server.
INS	Stores install information created by using the SET INSTALL command.
JPG	(Joint Photographic Experts Group) graphic image file.
KEY	Public portion of an RSA key.
LIC	Licence information.
LOG	Log file.
MDS	Modem script.
PAT	Patch.
PAZ	Compressed patch.
REL	Software release.
REZ	Compressed release.

Table 5: File extensions and file types. (Continued)

Extension	File type/function
SCP	Script.
SPA	Spam Mail Source files, listing email addresses, identified as spam mail sources, to be blocked by the firewall SMTP proxy, if it is active.
SPL	VPN client.
TXT	Generic text file.
VPF	Future VPN client.

You may see files on your router with file name extensions not listed in Table 5 on page 30. If you require more information about file types and file name extensions, contact your authorised distributor or reseller.

Do not change the header in a release or patch file. At best, this will cause the file load or install to fail, at worst the router could be put into a state where it will not boot correctly until field service action is taken.

Loading Files

The LOADER module is responsible for loading and storing releases, patches, PKI certificates and other files into FLASH. The LOADER module uses the Trivial File Transfer Protocol (TFTP), Hypertext Transfer Protocol (HTTP), or ZMODEM over an asynchronous port, to retrieve files from a network host.

You can also load text files without using any of these protocols. For information about using Lightweight Directory Access Protocol (LDAP) to load PKI certificates or certificate revocation lists (CRLs), see the *Operation* chapter in the *AR400 Series Router Software Reference*.

The router's default download method is TFTP. To load a file onto the router from a TFTP server using the TFTP protocol, enter the command:

```
LOAD [METHOD=TFTP] [DELAY=delay] [DESTINATION=FLASH]
   [SERVER={hostname|ipadd}] [SRCFILE|FILE=filename]
```

To load a file onto the router using the HTTP protocol, enter the command:

```
LOAD [METHOD={HTTP|WEB|WWW}] [DELAY=delay]
   [DESTFILE=destfilename] [DESTINATION=FLASH]
   [HTTPPROXY={hostname|ipadd} [PASSWORD=password]
   [PROXYPORT=1..65535]] [SERVER={hostname|ipadd}]
   [SERVPORT={1..65535|DEFAULT}] [SRCFILE|FILE=filename]
   [USERNAME=username]
```

The router can only load one file at a time. Wait for the current transfer to complete before initiating another transfer. To display the default configuration of the LOADER module, and the progress of any current transfer, enter the command:

```
SHOW LOADER
```

To stop a load at any time, leaving the LOADER module ready to load again, enter the command:

```
RESET LOADER
```

Setting LOADER Defaults

You are likely to repeat the process of downloading files onto the router using a similar method each time. You can set defaults for some or all of the LOADER parameters. You can then use or override some or all of these defaults for each particular load.

To set LOADER defaults, enter the command:

```
SET LOADER [ATTRIBUTE={CERT|CRL|CACERT|DEFAULT}]
    [BASEOBJECT={dist-name|DEFAULT}] [DELAY={delay|DEFAULT}]
    [DESTFILE=dest-filename] [DESTINATION={FLASH|DEFAULT}]
    [HTTPPROXY={hostname|ipadd|DEFAULT}]
    [METHOD={HTTP|LDAP|TFTP|WEB|WWW|ZMODEM|NONE|DEFAULT}]
    [PASSWORD=password] [PROXYPORT={1..65535|DEFAULT}]
    [{SCRFILE|FILE}=filename]
    [SERVER={host-name|ipadd|DEFAULT}]
    [SERVPORT={1..65535|DEFAULT}] [USERNAME=username]
```

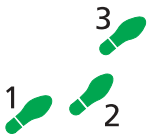
You can set all parameters except DESTFILE, SCRFILE and FILE back to the factory defaults with the option DEFAULT.

For more information about setting the LOADER defaults on your router, see the *Operations* chapter in the *AR400 Series Router Software Reference*.

Example: Load a Patch File Using HTTP

This example loads a patch file onto the router from a HTTP server on the network. Before following this procedure, make sure:

- The HTTP server is operating on a host with an IP address (for example 192.168.1.1) on the network, and that the patch file is in the server's HTTP directory.
- The router has an IP address (for example 192.168.1.2) on the interface connecting it to the HTTP server, and that it can communicate with the server.
- There is enough space in the router's FLASH for the new patch files.



To load a patch file

1. **Configure the LOADER.**

   Set the LOADER module with defaults to make the process of downloading files in future simpler.

   ```
   SET LOADER METHOD=HTTP SERVER=192.168.1.1
       DESTINATION=FLASH
   ```

2. **Download the patch file.**

   Download the patch file onto the router, using the defaults set above.

   ```
   LOAD FILE=52232-01.paz
   ```

   When the download has completed, check that the file is in FLASH.

   ```
   SHOW FILE
   ```

   This shows the file `52232-01.paz` is present.

To activate the patch see "*To upgrade to a new patch file:*" on page 37.

Uploading Files From the Router

The LOADER can upload files from the router to a network host, using TFTP or ZMODEM. Upload files using one of the commands:

```
UPLOAD [METHOD=TFTP] [FILE=filename]
   [SERVER={hostname|ipadd}]

UPLOAD [METHOD=ZMODEM] [FILE=filename] [ASYN=port]
```

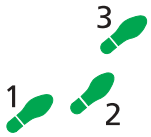
The UPLOAD command uses defaults set with the SET LOADER command, for parameters not specified with the upload command.

You can install Allied Telesyn's Trivial File Transfer Protocol Server (AT-TFTPD on any PC or server running Windows. This will provide a simple way to make files available to all Allied Telesyn routers and layer 3 switches in your network. The TFTP Server, and a readme file describing how to install and use it, are provided on the *AR400 Series Router Documentation and Tools CD-ROM*.

Example: Upload a Configuration File Using TFTP

This example uploads a configuration file from the router to a TFTP server on the network. Before following this procedure, make sure:

- The TFTP server is operating on a host with an IP address (for example 192.168.1.3) on the network.
- The router has a valid IP address (for example 192.168.1.2) on the interface connecting it to the TFTP server, and that it can communicate with the server.
- The configuration file is present in the router's FLASH.



To upload a log file:

1. **Configure the LOADER.**

   Set the LOADER module with defaults to make the process of downloading and uploading files in future simpler.

   ```
   SET LOADER METHOD=TFTP SERVER=192.168.1.3
   ```

2. **Upload the configuration file.**

   Upload the log file from the router into the TFTP directory of the TFTP server on the network, using the defaults set above.

   ```
   UPLOAD FILE=filename.log
   ```

   Monitor the load progress.

   ```
   SHOW LOAD
   ```

   When the upload is complete, check that the file is in the TFTP directory on the network host.

More information

For more information about loading files onto and uploading files from the router, including using LDAP to load PKI certificate information, see the *Operation* chapter in the *AR400 Series Router Software Reference*.

Upgrading Router Software

When you first start the router, it automatically loads the software release from FLASH memory into RAM, where the CPU uses it to run all the router's software features. The router may also load a patch file to improve the main release. The software release and any patch files are current when the router is produced at the factory.

When Allied Telesyn makes a new patch or release available, you may want to upgrade the software on your router to use a new patch or release file. You can download the latest software patches, full software releases, and CLI help files from the support site at: http://www.alliedtelesyn.co.nz/support/ar400.

Make sure you download a patch or release file that matches your router model. A patch or release file for an AR400 Series router has 52 as the first two digits of the filename. Patch files have the file extension `.paz` and release files have the file extension `.rez`. For example, the Software Release 2.4.1 for the AR400 Series router has the filename `52-241.rez`.

Release and patch files are compressed ASCII files, and consist of a header followed by a sequence of Motorola S-records containing the actual code for the release or patch. The header has a standard format, which provides information about the release or patch to the router.

Do not change the header in a release or patch file. At best, this will cause the file load or install to fail, at worst the router could be put into a state where it will not boot correctly until field service action is taken.

The current release and patch file are set as the preferred install. The router also has a very limited version of the software stored in permanent memory (EPROM). You cannot delete this version as it is the default, or boot install. When you load a new software release or patch, you can set it to run once, the next time the router reboots. This temporary install allows you to test run a new release or patch once, before you make it the preferred install. If the temporary install fails the router will automatically run the preferred install if there is one, or otherwise the default install, the next time the router reboots.

When the router reboots, it checks the install information in a strict order:

- Firstly, the router checks the temporary install. If a temporary install is specified, the router loads it into RAM and runs it. At the same time, it deletes the temporary install information so it will not load a second time. This information is deleted even if the temporary install triggers a fatal condition causing the router to reboot immediately.
- Secondly, if no temporary install is defined, or the install information is invalid, the router checks the preferred install. If present, this install is loaded. The router never deletes the preferred install information.
- Thirdly, if neither a temporary install nor a preferred install is specified, the router loads the default install. The default install is always present in the router because if, for some reason, it is not, the INSTALL module will restore it.

The preferred install should not be set up with an untested release or patch. It is advisable to install new releases or patches as the temporary install, and when the router boots correctly, to then set up the preferred install with the new release or patch.

To change the install information in the router, enter the command:

```
SET INSTALL={TEMPORARY|PREFERRED|DEFAULT}
    [RELEASE={release-name|EPROM}] [PATCH=patch-name]
```

For security reasons the SET INSTALL command is only accepted if the user has SECURITY OFFICER privilege.

When you set a patch file as part of a temporary install or permanent install, you must also set the corresponding release file in the same command, if it has not already been set as part of that install. You can set the patch, but not the release (always EPROM), for the default install.

To delete a temporary install or preferred install, enter the command:

```
DELETE INSTALL={TEMPORARY|PREFERRED}
```

If a default install is set, only the patch information is deleted using the DELETE INSTALL command as the release information must always be left intact in the default install.

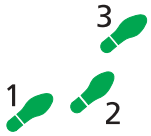
To display the current install information, including which install is currently running in the router, and how the install information was checked at the last reboot, enter the command:

```
SHOW INSTALL
```

For more information about INSTALL commands, see the *Operations* chapter in the *AR400 Series Router Software Reference*.

Example: Upgrade to a New Software Release Using TFTP

This example assumes the router is correctly configured to allow TFTP to function. This means that IP is configured and the router is able to communicate with the designated TFTP server. The TFTP server is assumed to function correctly and the release and patch files are assumed present in the server's TFTP directory. The router has no release or patch files, and is running the EPROM Software Release 2.3.2. The IP address of the server is 172.16.1.1. The name of the release file being loaded is `52-241.rez`.



To upgrade to a new software release:

1. **Configure the LOADER.**

   The LOADER module is set up with defaults to make the process of downloading files in future simpler. All release and patch files in this router are stored in FLASH.

   ```
   SET LOADER METHOD=TFTP SERVER=172.16.1.1 DEST=FLASH
   ```

2. **Load the new release file onto the router.**

   Make sure there is space in FLASH for the new release file. Load the new file onto your router. Make sure the release file matches your router model (see "*Upgrading Router Software*" on page 34). Load any patch files required, and the help file for the release (see "*Loading and Uploading Files*" on page 30). To load the release file using your LOADER default settings, enter the command:

   ```
   LOAD FILE=52-241.rez
   ```

Wait for the release to load. This can take 5 to 10 minutes or more, even if you are loading the file over a high speed link. To see the progress of the load, enter the command:

```
SHOW LOAD
```

To check that the files are successfully loaded, enter the command:

```
SHOW FILE
```

3. Enter licence information for the release.

Enter the licence password for the software release.

```
ENABLE RELEASE=52-241.rez PASSWORD=ce645398fbe
   NUMBER=2.4.1
```

The release licence password is provided by your authorised distributor or reseller and is unique for the release number (in this case 2.4.1), the file name and the router's serial number.

Enter passwords for any special feature licences.

```
ENABLE FEATURE=feature PASSWORD=password
```

4. Test the release.

Set the new release to run as a temporary install. This sets the router to load the new release once only when it reboots.

```
SET INSTALL=TEMPORARY RELEASE=52-241.rez
   [PATCH=52241-01.paz]
```

If you want to use the current router configuration again, store the dynamic configuration as a configuration script file and set the router to use this configuration when it restarts. Releases are generally backward-compatible, so your current configuration should run with little or no modifications on the later release.

```
CREATE CONFIG=myconfig.cfg
```

```
SET CONFIG=myconfig.cfg
```

The SET CONFIG information survives the release update.

Reboot the router.

```
RESTART REBOOT
```

The router reboots, loading the new release file and the specified configuration. Display the install history, and check that the temporary release was loaded.

```
SHOW INSTALL
```

5. Make the release the default (permanent) release.

If the router operates correctly with the new release, make the release permanent.

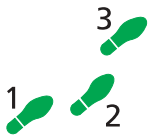
```
SET INSTALL=PREFERRED RELEASE=52-241.rez
```

Every time the router reboots from now on, it loads the new release from FLASH.

Do not set an untested release or patch as part of the preferred install.

Example: Upgrade to a new patch file

Use this procedure to upgrade the software release currently running on the router with a new patch. This example assumes that the current release, Software Release 2.3.2, is set as the preferred release.



To upgrade to a new patch file:

1. **Load the new patch file onto the router.**

   Load the new file onto your router. See "*Loading and Uploading Files*" on page 30.

   ```
   LOAD FILE=52232-02.paz
   ```

   Check that the file is successfully loaded.

   ```
   SHOW FILE
   ```

2. **Test the patch.**

   Set the release to run as a temporary install, so that it loads the patch once only the next time it reboots.

   ```
   SET INSTALL=TEMPORARY RELEASE=52-232.rez
       PATCH=52232-02.paz
   ```

   If you want to use the current router configuration again, store the dynamic configuration as a configuration script file, and set the router to use this configuration when it restarts.

   ```
   CREATE CONFIG=myconfig.scp
   ```

   ```
   SET CONFIG=myconfig.scp
   ```

   Reboot the router.

   ```
   RESTART REBOOT
   ```

   The router reboots, loading the new patch file and the specified configuration. Check that the router operates correctly with the new patch file.

3. **Make the patch part of the default (permanent) release.**

   If the router operates correctly with the new patch, make the release permanent.

   ```
   SET INSTALL=PREFERRED RELEASE=52-232.rez
       PATCH=52232-02.paz
   ```

   Every time the router reboots from now on, it loads the new release and patch from FLASH.

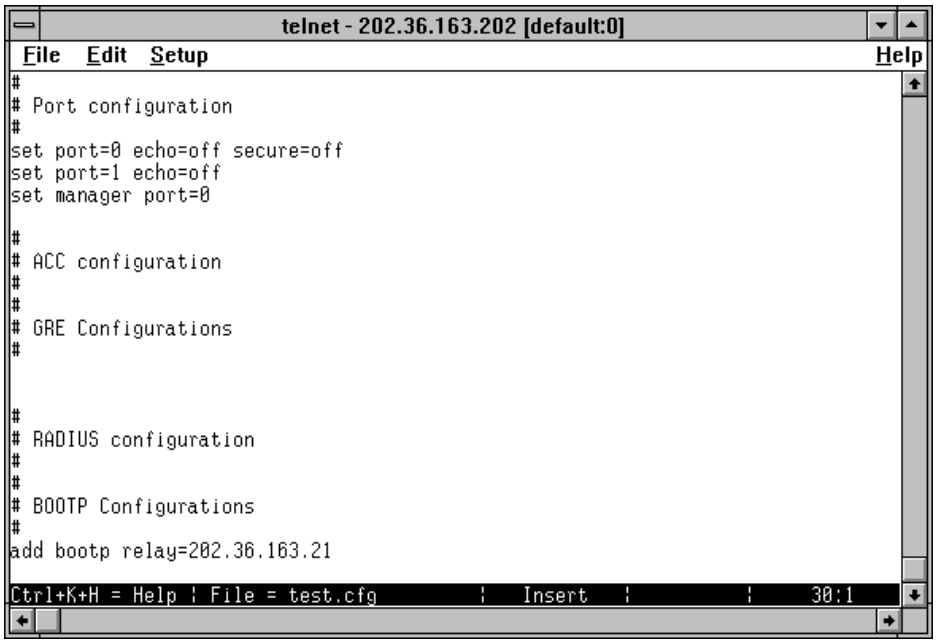
Do not set an untested patch as part of the preferred install.

Using the Built-in Editor

The AR400 Series router has a built-in full-screen text editor for editing script files stored on the router file subsystem. Using the text editor you can run script files manually, or set script files to run automatically at router restart, or on trigger events. Figure 3 on page 38 shows a example screen shot of the text editor. To start the editor with a new file or an existing file, enter the command:

```
EDIT [filename]
```

Figure 3: The editor screen layout.



The editor uses VT100 command sequences and should only be used with a VT100-compatible terminal, terminal emulation program or Telnet client.

To display editor Help at any time while in the editor press [Ctrl/K,H]; that is, hold down the Ctrl key and press in turn the K key then the H key.

For more information about the inbuilt editor, see the *Operation* chapter in the *AR400 Series Router Software Reference.*

SNMP and MIBs

You can remotely monitor some features of the router using Simple Network Management Protocol (SNMP).

The following MIBs are supported:

- MIB II (RFC 1213)
- Ethernet MIB (RFC 1643)
- AR router portion of the ATI/ATKK Enterprise MIB
- Frame Relay DTE MIB (RFC 1325)
- Bridge MIB (RFC 1493)

- Host Resources MIB (RFC 1514)
- DS1, E1, DS2, and E2 Interface Types MIB (RFC 2495)

The SNMP agent is disabled by default. To enable SNMP, enter the command:

```
ENABLE SNMP
```

SNMP *communities* are the main configuration item in the router's SNMP agent, and are defined in terms of a list of IP addresses which define the SNMP application entities (trap hosts and management stations) in the community. To create an SNMP community, enter the command:

```
CREATE SNMP COMMUNITY=name [ACCESS={READ|WRITE}]
    [TRAPHOST=ipadd] [MANAGER=ipadd]
    [OPEN={ON|OFF|YES|NO|TRUE|FALSE}]
```

The community name is a security feature and you should keep it secure.

To enable the generation of authentication failure traps by the SNMP agent whenever an SNMP authentication failure occurs, enter the command:

```
ENABLE SNMP AUTHENTICATE_TRAP
```

To enable the generation of link state traps for a specified interface, enter the command:

```
ENABLE INTERFACE=interface LINKTRAP
```

where *interface* is the name of an interface, such as "vlan11".

For more information see the *Simple Network Management Protocol (SNMP)* chapter and the *Interfaces* chapter in the *AR400 Series Router Software Reference*.

To display the current state and configuration of the SNMP agent, enter the command:

```
SHOW SNMP
```

For a detailed description of the output from the SHOW SNMP command, see the *Simple Network Management Protocol (SNMP)* chapter in the *AR400 Series Router Software Reference*.

For more information about the MIBs supported by the router, see *Appendix C: SNMP MIBs* in the *AR400 Series Router Software Reference.*

For More About Operations and Facilities

For more detail about operating the router, and for full command syntax definitions, see the *Operation* chapter in the *AR400 Series Router Software Reference*, including:

- How to use the User Authentication Facility, RADIUS or TACACs for authenticating users who log on to the router, and ensuring that only authorised login accounts are used.
- How to use the HTTP Client, which you can use to download software files onto the router, and the HTTP Server.
- How to use the Mail Subsystem.
- How to use LDAP to load PKI certificates and CRLs onto your router.
- How to use Switch Startup Operations

- How to use FLASH compaction to regain storage space on the router. Read "*Warning about FLASH memory*" on page 14 before you attempt to do this.
- How to set *aliases* to represent common command strings.
- How to define a *remote security officer*, so you can manage the security features remotely via Telnet.

See other chapters in the *AR400 Series Router Software Reference* for more information on how to:

- Use the logging facility to monitor network activity and to select and display the results (see the *Logging Facility* chapter).
- Use SNMP to manage the router remotely (see the *Simple Network Management Protocol (SNMP)* chapter and *Appendix C: SNMP MIBs*).
- Use the command line to create, delete and modify configuration scripts (see the *Scripting* chapter).
- Set up triggers to automatically run specified scripts at specified times, or at specified events (see the *Trigger Facility* chapter).
- Use NTP to synchronise your router's time clock with those of other network devices (see the *Network Time Protocol (NTP)* chapter).
- Use software to test whether the router's hardware functions correctly (see the *Test Facility* chapter).

Chapter 4

Physical and Layer 2 Interfaces

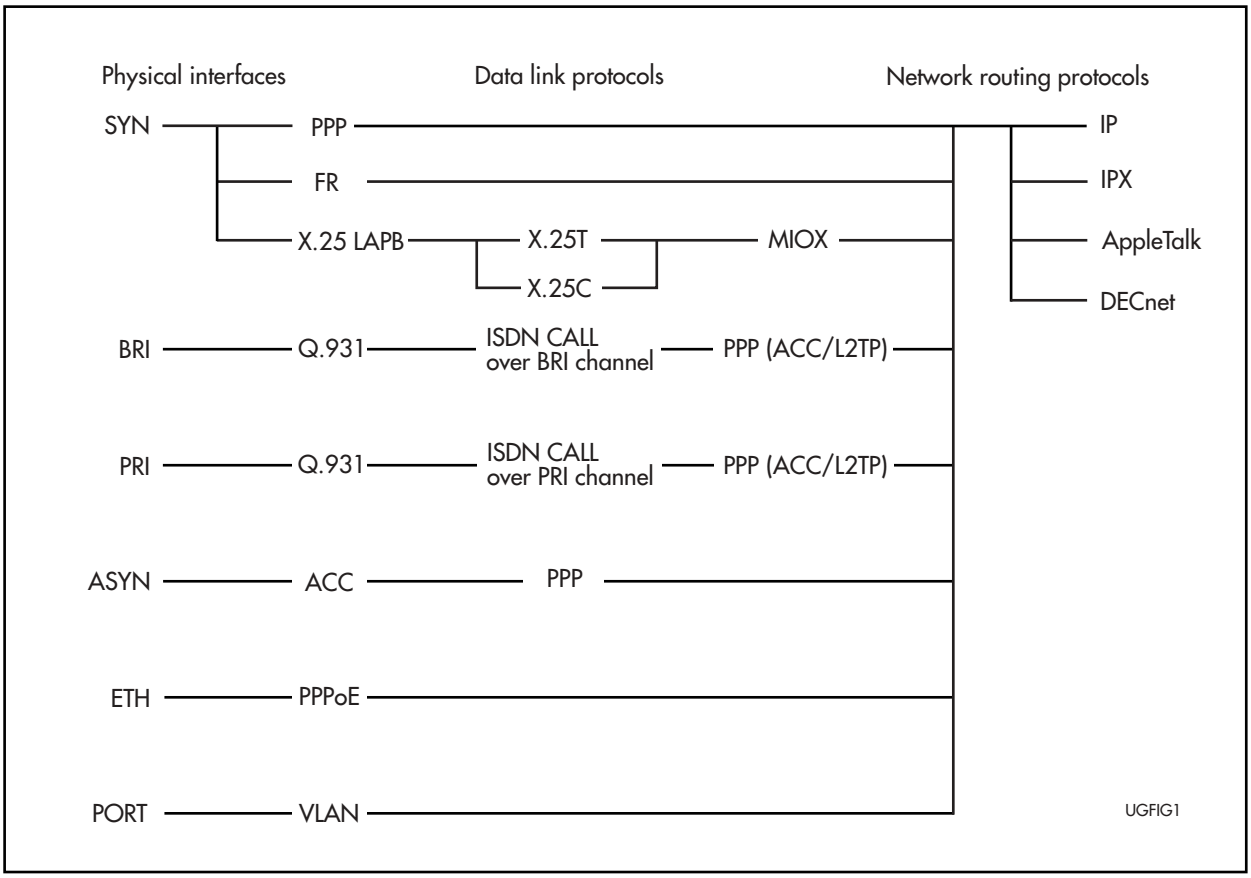
This Chapter

This chapter introduces the physical and logical interfaces available on the base unit router and the optional interfaces available as expansion options for the PIC bay. Topics covered are:

- "*Interfaces*" on page 42
- "*Naming Interfaces*" on page 43
- "*Ethernet Ports*" on page 44
- "*Asynchronous Port*" on page 44
- "*Synchronous Ports*" on page 46
- "*Switch Ports*" on page 46
- "*Virtual LANs*" on page 48
- "*Point to Point Protocol (PPP)*" on page 49
- "*Frame Relay*" on page 50
- "*Integrated Services Digital Network (ISDN)*" on page 53
- "*Configuring ISDN*" on page 55
- "*Installing Port Interface Cards (PICs)*" on page 62

Once you have configured the Layer 2 interfaces, you can configure a Layer 3 protocol to route traffic between these interfaces. A simple network overview showing the relationship between physical interfaces, data link protocols, and network routing protocols is shown in Figure 4 on page 42.

Figure 4: Network overview.



Interfaces

The physical interfaces on the base unit or expansion option, sometimes called ports, connect the router to the physical network. All data enters and leaves the router via an interface. The interface on the router and the device at the other end of the link must use the same encapsulations for the Layer 2 protocol.

You can use the asynchronous console port on the base unit, *asyn0*, to configure the router (see "*Asynchronous Port*" on page 44 and the *Interfaces* chapter in the *AR400 Series Router Software Reference*).

Additional asynchronous ports can also connect terminals, printers and terminal ports on host computers (see the *Terminal Server* and the *Printer Server* chapters in the *AR400 Series Router Software Reference*).

Switch ports are numbered from 1. By default, all switch ports are enabled and set to autonegotiate. Autonegotiation allows switch ports to adjust their speed and duplex mode to accommodate the devices connected to them (see "*Switch Ports*" on page 46 and the *Switching* chapter in the *AR400 Series Router Software Reference*).

Switch ports are grouped into logical interfaces called Virtual LANs (VLANs), numbered from 1. You can create and modify the default VLAN configuration if necessary (see "*Virtual LANs*" on page 48 and the *Switching* chapter in the *AR400 Series Router Software Reference*).

Two of the encapsulations supported for synchronous ports—Frame Relay and Point-to-Point Protocol—are described in detail in the *Point-to-Point Protocol (PPP)* and *Frame Relay* chapters in the *AR400 Series Router Software Reference*.

The Basic Rate and Primary Rate ISDN interfaces are described in the *Integrated Services Digital Network (ISDN)* chapter in the *AR400 Series Router Software Reference*.

Naming Interfaces

When you configure an interface, and configure routing over that interface, you can refer to a physical interface by its simple name or its fully qualified name.

The simple name for an interface is the interface type, followed by the interface number. The interface type is an abbreviation of the full name of the interface (see Table 6 on page 43). The fully qualified name for expansion option ports includes the expansion bay and the number of the interface within the bay.

Table 6: Interface type names.

Type	Description
Physical interfaces	
PORT	Ethernet switch port interface, numbered from 1 (including uplinks)
ASYN	Asynchronous interface
BRI	Basic Rate ISDN interface
ETH	Ethernet interface (excluding switch ports)
PRI	Primary Rate ISDN interface
SYN	Synchronous interface
Logical interfaces	
VLAN	Virtual LAN interface over switch ports, numbered from 1
FR	Frame Relay interface
LAPB	X.25 LAPB interface
PPP	Point-to-Point Protocol interface
X25C	X.25 DCE interface
X25T	X.25 DTE interface

When you use commands with a physical interface as a parameter, you have the option to use either the simple name or the fully qualified name of the interface.

For examples of valid simple names and the equivalent fully qualified names see the *Interfaces* chapter in the *AR400 Series Router Software Reference*.

To display a summary of all the interfaces on the router, enter the command:

```
SHOW INTERFACE
```

Ethernet Ports

An Ethernet interface on the router is automatically configured by the software modules when the router starts up. No user configuration of the Ethernet interfaces is required, except to enable other software modules to use the interface. This is achieved by adding a software module interface and using the clause INTERFACE=*ethn*, where *n* is the number of the Ethernet interface being configured. For example, to add a logical interface to the IP module, enter the command:

```
ADD IP INTERFACE=eth0 IPADDRESS={ipadd|DHCP}
```

To display the modules in the router that are configured to use an Ethernet interface, and the encapsulations used on an interface, enter the command:

```
SHOW ETH=n CONFIGURATION
```

where *n* is the number of the Ethernet interface.

For more information about Ethernet interfaces and encapsulations, see the *Interfaces* chapter in the *AR400 Series Router Software Reference.*

Asynchronous Port

Asynchronous ports are normally used to connect a terminal to the router for configuration purposes. The default values for configurable parameters are modified by entering the command:

```
SET ASYN=port-number option
```

The factory default settings for asynchronous ports are shown in Table 7 on page 44.

Table 7: Factory defaults for configurable parameters for asynchronous ports.

Option	Default setting
ATTENTION	BREAK
CDCONTROL	IGNORE
DATABITS	8
DEFAULTSERVICE	FALSE
DTRCONTROL	ON
ECHO	ON
FLOW	HARDWARE
HISTORY	30
INFLOW	HARDWARE
IPADDRESS	NONE
IPXNETWORK	NONE
MAXOQLEN	0 (Unrestricted)
MTU	1500
NAME	Asyn #
OUTFLOW	HARDWARE
PAGE	22

Table 7: Factory defaults for configurable parameters for asynchronous ports.

Option	Default setting
PARITY	NONE
PROMPT	DEFAULT (CMD>)
SECURE	ON
SERVICE	NONE
SPEED	AUTO
STOPBITS	1
TYPE	VT100

For more information about asynchronous ports, see the *AR Series Router Hardware Reference* or the *Interfaces* chapter in the *AR400 Series Router Software Reference.*

For more information about configuring PPP interfaces across an asynchronous interfaces, see the *Point to Point Protocol (PPP)* chapter in the *AR400 Series Router Software Reference.*

Asynchronous Call Control (ACC)

You can configure the ACC module to answer calls made to a modem connected to an asynchronous port, to validate the user making the call and to configure the port to the mode appropriate for the desired service. Also, you can configure ACC to originate calls by controlling a modem attached to an asynchronous port and to switch the port to the appropriate mode once a connection to the remote device is established.

To assign a user an IP address and MTU (Maximum Transmission Unit) for use with an ACC call, enter the command:

```
SET USER=login-name IP=ipadd MTU=mtu
```

To assign an IP address and MTU to the asynchronous port accessed by the ACC call, enter the command:

```
SET ASYN=asyn-number IP=ipadd MTU=mtu
```

For more information about ACC, see the *Asynchronous Call Control (ACC)* chapter in the *AR400 Series Router Software Reference.*

Synchronous Ports

You can use the asynchronous console port on the base unit to configure the router. Additional asynchronous ports can also connect terminals, printers and terminal ports on host computers.

Your router supports synchronous interfaces with speeds of up to 2.048 Mbps, also known as E1. The router will automatically generate a clock signal when a DCE transition cable is connected to a synchronous interface (see the *AR Series Router Hardware Reference* for details of how to construct a cable).

To set the clock speed, enter the command:

```
SET SYN=n SPEED=speed
```

For more information about synchronous interfaces, see the *Interfaces* chapter in the *AR400 Series Router Software Reference.*

Switch Ports

A switch port is one of the physical Ethernet interfaces on the base router unit. Each switch port is uniquely identified by a port number.

To display information about switch ports, enter the command:

```
SHOW SWITCH PORT[={port-list|ALL}]
```

All switch ports on the router are enabled by default. You can disable and enable a switch port as required. To enable or disable a switch port, enter the commands:

```
ENABLE SWITCH PORT={port-list|ALL}
```

```
DISABLE SWITCH PORT={port-list|ALL}
```

Port Speed and Duplex Mode

Each switch port can operate at either 10 Mbps or 100 Mbps, in either full duplex or half duplex mode. In full duplex mode a port can transmit and receive data simultaneously, while in half duplex mode the port can either transmit or receive, but not at the same time. This versatility makes it possible to connect devices with different speeds and duplex modes to different ports on the router. Such versatility also requires that each port on the router know which speed and mode to use. The ports can automatically adjust their speed and duplex mode to accommodate the devices connected to them. This adjustment is referred to as “autonegotiation”.

You have two options when you configure switch ports. Firstly, you can configure each switch port with a fixed speed and duplex mode. Secondly, you can configure each switch port to autonegotiate speed and duplex mode with a device connected to it to determine a speed and mode that will allow successful transmission. An autonegotiating port will adopt the speed and duplex mode required by devices connected to it. If another autonegotiating device is connected to the router, they will negotiate the highest possible common speed and duplex mode (Table 8 on page 47). Setting the port to a fixed speed and duplex mode allows it to support equipment that cannot autonegotiate. When a port at one end of the link is set to a fixed speed (non-autonegotiating) set the port at the other end of the link to operate at the same speed. This is because when autonegotiation is disabled, the link partner is not

able to determine the duplex mode of the link and must be forced to use the correct mode. Switch ports autonegotiate by default when they are connected to a new device.

To force ports to use a fixed speed and duplex mode, enter the command:

```
SET SWITCH PORT={port-list|ALL}
   SPEED={AUTONEGOTIATE|10MHALF|10MFULL|100MHALF|100MFULL}
```

Table 8: Autonegotiation preferences for switch ports.

Preference	10/100 Ethernet switch ports
Highest	100 Mbps, Full duplex
	100 Mbps, Half duplex
	10Mbps, Full duplex
Lowest	10Mbps, Half duplex

Limiting Switch Traffic

You can make some choices about how switch ports respond when there is more traffic than the network or the switch ports can handle easily. Any choices you make affect all switch ports on the base router unit.

The default settings for commands that limit traffic are adequate for most situations.

By default, back pressure for flow control for half duplex ports is turned on:

```
SET SWITCH BACKPRESSURE=ON
```

By default, flow control using pause frames for full duplex ports is turned on:

```
SET SWITCH FLOWCONTROL=ON
```

Once the system resource becomes available the switch transmission by the link partner of the port can resume.

You can set the global retransmission time delay for all switch ports operating in half duplex mode. When the port attempts to transmit a packet and encounters a collision, the switch stops transmission and starts a short delay (backoff) before attempting re-transmission. If AGGRESSIVE is specified, the time delay is shorter. If NORMAL is specified, the time delay is standard. The default is NORMAL.

```
SET SWITCH BACKOFF={AGGESSIVE|NORMAL}
```

By default, switch ports will repeat attempts to transmit a packet until they succeed:

```
SET SWITCH EXCESSIVECOLLISION=RETRY
```

Packet buffers available in the buffer pool are shared by all switch ports. By default, these are allocated automatically according to the amount of traffic at each port (ADAPTIVE). To limit the number of buffers available for any port, enter the command:

```
SET SWITCH BUFFERPOOL={EQUAL|ADAPTIVE}
```

By default, broadcast and multicast packets are discarded if they are in excess of 25% the line rate:

```
SET SWITCH BROADCASTLIMIT=ON
```

For more information about limiting switch traffic, see the *Switching* chapter in the *AR400 Series Router Software Reference*.

Virtual LANs

A Virtual LAN (VLAN) is a software-defined broadcast domain. The router's VLAN feature allows you to segment a network by software management to improve network performance. You can group workstations, servers, and other network equipment connected to the router according to similar data and security requirements. This is done by allocating the switch ports on the router to VLANs, each of which is a separate broadcast domain.

By default, the router has one VLAN, the default VLAN, with a VLAN Identifier (VID) of 1. All switch ports belong to the default VLAN, and all ports send untagged packets. You cannot delete the default VLAN from the router.

If all you want the router to do is switch traffic on your LAN using the default VLAN configuration, you need not perform any configuration. Simply power up the router and connect devices to the switch ports. Switch learning is enabled by default, and all valid packets are forwarded.

To create a new VLAN on the router, specify a vlanname and VID that are unique in the router. Enter the command:

```
CREATE VLAN=vlanname VID=2..4094
```

You cannot delete the default VLAN, but to delete other VLANs if they have no member ports, enter the command:

```
DESTROY VLAN={vlanname|2..4094|ALL}
```

Any port in the default VLAN can be added to another VLAN, and is then automatically removed from the default VLAN. Each port can only belong to one VLAN. To add an untagged port to a VLAN, enter the command:

```
ADD VLAN={vlanname|2..4094} PORT={port-list|ALL}
```

To return ports to the default VLAN, enter the command:

```
DELETE VLAN={vlanname|2..4094} PORT={port-list|ALL}
```

To display the VLANs configured on the router, enter the command:

```
SHOW VLAN[={vlanname|1..4094|ALL}
```

To enable communication between ports in different VLANs, you need to configure IP or another Layer 3 protocol over the VLAN interfaces.

Point to Point Protocol (PPP)

The Point-to-Point Protocol (PPP) establishes a connection between the router and a service provider, on demand. PPP provides mechanisms for transmitting data over synchronous connections, ISDN, ACC and L2TP calls, groups of TDM slots, and Ethernet.

Each protocol carried over PPP has an associated Network Control Protocol (NCP) that negotiates options for the protocol and brings up the link for that protocol.

To create or destroy a PPP interface over a synchronous port, an ISDN call, an ACC call, a MIOX circuit, an L2TP call, a TDM group (referred to as a physical layer) or a PPP over Ethernet service, enter the command.

```
CREATE PPP=ppp-interface OVER=physical-interface
DESTROY PPP=ppp-interface
```

To add or delete a synchronous port, an ISDN call, an ACC call, a MIOX circuit, an L2TP call, TDM group or a PPP over Ethernet service to the PPP interface, enter the command:

```
ADD PPP=ppp-interface OVER=physical-interface
DELETE PPP=ppp-interface OVER=physical-interface
```

where:

- *physical-interface* is SYN*n*, ISDN-*callname*, ACC-*callname*, MIOX*n-circuitname*, TNL-*callname*, TDM-*groupname* or ETH*n-servicename*. For PPP over Ethernet, to specify that any service name is acceptable, use the special service name ANY. Service names may be up to 18 characters in length, and are usually supplied by the ISP providing the service.

There are many configurable parameters for PPP interfaces that you can modify using the SET PPP command.

By default, Allied Telesyn routers and layer 3 switches use Link Quality Reporting (LQR=ON) to determine link quality on PPP links. When connecting to some vendors' routers it may be more suitable to turn LQR (link quality reporting) off on PPP links (LQR=OFF), and instead use LCP Echo Request and Echo Reply messages to determine link quality (ECHO=ON):
SET PPP=ppp-interface ECHO=ON LQR=OFF

For more information about PPP, see the *Point to Point Protocol (PPP)* chapter in the *AR400 Series Router Software Reference.*

Dynamic PPP Interfaces and PPP Templates

A request from a lower layer (ISDN, ACC or L2TP) to create a new PPP interface creates a Dynamic PPP interface. PPP templates are blueprints that enable the full range of configuration options available on static PPP interfaces to apply to dynamic PPP interfaces.

You can use a template to specify any of the parameters configurable on a static PPP interface. Once a template is created, this template can be associated with an ISDN, ACC or L2TP call.

PPPoE

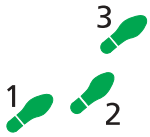
PPP over Ethernet (PPPoE) is defined in RFC 2516 "*A Method of Transmitting PPP Over Ethernet*". PPPoE is used to run PPP over the Ethernet. The same authentication, billing and transfer systems as for PPP are then available in Ethernet networks.

PPP over Ethernet enables multiple hosts at a remote site to share the same access device, while providing the access control and billing functionality of dial-up PPP connections.

The router behaves as a host, as defined in RFC 2516, creating PPP links over Ethernet to services on remote *Access Concentrators*.

Frame Relay

Frame Relay is a wide area network service, defined by ITU-T (formerly CCITT), ANSI and vendor standards, to which routers may connect in order to communicate with one another and exchange data. Frame Relay is one of the services that you can purchase from a service provider to link several offices together at high speed. Connections are made via synchronous lines, ISDN calls or G.703 TDM (*Time Division Multiplexing*) links.



To configure Frame Relay follow these steps

The following steps are required:

1. Create the Frame Relay interface.
2. Add Static DLCs if required.
3. Add Logical Interfaces if required.
4. Enable routing modules to use the interface.

1. Create the Frame Relay interface

To create and associate the Frame Relay interface with a synchronous interface or an ISDN call, enter the command:

```
CREATE FR=n OVER=physical-interface
```

where *n* is the number of the Frame Relay interface and *physical-interface* is a synchronous interface such as "syn0" or an ISDN call such as "isdn-Head Office".

To display each Frame Relay interface, the physical interface it uses, and the logical interfaces it provides, enter the command:

```
SHOW FRAMERELAY
```

A feature of Frame Relay is the dialogue that the network maintains with the devices connected to it. This dialogue is known as the Local Management Interface (LMI). A LMI is not provided by all Frame Relay networks. Your router supports Frame Relay networks that do not run the LMI by allowing the configuration of static Data Link Connections (DLCs).

Parameters that affect the LMI dialogue are also set with the CREATE command. These parameters, and the values that they can take, are defined in the Frame Relay standards. Default values for the LMI parameters are defined in the standards, and are used when parameters are not supplied.

Consult your Frame Relay network provider before making changes to the parameters that affect the LMI dialogue.

Parameters for setting the interface defaults for encryption and compression are also set with the CREATE command. These values are used by all DLCs on the interface unless specifically overridden for a particular DLC.

After the Frame Relay interface is created, to change the LMI parameters, enter the command:

```
SET FRAMERELAY
```

You may modify any or all of the parameters on a single command line. However, only ENCAPSULATION, NT1, NN1, NN2 and NN3 parameter changes take effect immediately. All other parameter changes cause the Frame Relay interface to reset automatically before they take effect.

To display the current values of the parameters, enter the command:

```
SHOW FRAMERELAY CONFIG
```

2. Add static DLCs if required

If the LMI dialogue is turned off for a Frame Relay interface, the router is not informed about active DLCs. Therefore you must set up static DLCs. To set up static DLCs, enter the command:

```
ADD FRAMERELAY=fr-interface DLC=dlci
    [COMPRESSION={DEFAULT|ON|OFF}]
    [ENCAPSULATION={DEFAULT|IETF|CISCO}]
    [ENCRYPTION={DEFAULT|ON|OFF}]
```

To remove static DLCs, enter the command:

```
DELETE FRAMERELAY DLC
```

If no encryption or compression parameters are specified when the DLC is added, the interface defaults, which are set via the DEFENCRYPTION and DEFCOMPRESSION parameters of the CREATE FRAMERELAY and the SET FRAMERELAY commands, are used for the DLC.

To set the encryption and compression parameters, and the CIR (Committed Information Rate), of an individual DLC, use the SET FRAMERELAY DLC command. If a parameter is set to a non-default value for a DLC that the router is not informed about by the LMI, a DLC is created to record this information. The DLC is put into the AWAIT_LMI state until the network informs the router via the LMI that the DLC is active.

Obtain the actual values to use for DLCs from the administrators of the Frame Relay network to which your router is connected. Communication across the Frame Relay network will only occur for those DLCs that are statically configured.

If the LMI dialogue is enabled it is not possible to use static DLCs. In this case, DLCs are learned through the LMI dialogue.

3. Add logical interfaces if required

Frame Relay logical interfaces (FRLI) provide a mechanism for organising DLCs into groups. Each FRLI, or group of DLCs, are assigned its own IP address to split the Frame Relay network into subnets. A default FRLI 0 is always created when a Frame Relay interface is created. To create additional FRLI's, enter the command:

```
ADD FRAMERELAY=fr-interface LI=logical-interface
```

By default, all DLCs are associated with the default FRLI 0. To associate DLCs with other FRLIs, enter the command:

```
SET FRAMERELAY=fr-interface DLC=dlci LI=logical-interface
```

4. Enable routing modules to use the interface

Once a Frame Relay interface is defined and configured, configure routing modules to use the interface. The procedures for achieving this are described in the chapter for the particular routing module.

In general, commands that contain the parameter INTERFACE= can refer to a Frame Relay interface by name. The form of the name is "fr*n*", where *n* is the instance for the Frame Relay module. Examples of commands that can refer to a Frame Relay interface include:

```
ADD IP INTERFACE=FRn...

ADD IPX CIRCUIT=circuit INTERFACE=FRn...

SET DNT ADD=INTERFACE INTERFACE=FRn...
```

One important point concerning the use of Frame Relay interfaces by the IP routing module is the way that the IP routing module maps IP addresses to a Frame Relay DLCI and vice versa. This mapping is an example of Address Resolution Protocol or ARP. Two methods of ARP are supported for Frame Relay interfaces on the router, Inverse ARP and static ARP.

The router supports the Inverse ARP, a protocol specially developed for Frame Relay that involves the exchange of packets between routers connected by a DLC in order to map an IP address to a Data Link Connection Identifier (DLCI). Inverse ARP is described in RFC 1293.

To enable the router to communicate with DTEs that do not support Inverse ARP, static ARP entries are added, by entering the command:

```
ADD IP ARP=ipadd INTERFACE=FRn DLCI=dlci
```

The use of static DLCs and static ARP information is not normally required for interoperation of the router with other vendors' equipment. These facilities are provided for interoperation with equipment that does not fully support the Frame Relay standards. Networks that consist purely of routers that support Inverse ARP will not need static ARPs.

Integrated Services Digital Network (ISDN)

To use ISDN connections with an AR400 Series router you need to install the appropriate Port Interface Card (PIC) in the router's PIC bay. Either install an ISDN Basic Rate ISDN (BRI) or Primary Rate ISDN (PRI) PIC. Depending on the PIC installed, the router supports the following types of ISDN connections:

- Basic Rate ISDN (U)
- Basic Rate ISDN (S/T)
- Primary Rate ISDN

BRI Versus PRI

LAPD is the Link Access Protocol for the ISDN D channel, as defined by ITU-T Recommendation Q.921. The major difference between Basic and Primary Rate Interfaces as far as LAPD is concerned is that BRI S/T interfaces use a bus configuration whereas PRI interfaces use a point-to-point configuration.

For more information about ISDN, see the *Integrated Services Digital Network (ISDN)* chapter in the *AR400 Series Router Software Reference.*

Configuring the Basic Rate Interface

The Basic Rate Interface (BRI) software module does not require user configuration for normal ISDN operation, but may require configuration when the interface is used for semipermanent connections.

To display the status of the BRI, enter the command:

```
SHOW BRI STATE
```

For more information about configuring BRI, see the *Integrated Services Digital Network (ISDN)* chapter in the *AR400 Series Router Software Reference.*

Configuring the Primary Rate Interface

The Primary Rate Interface (PRI) software module requires minimal user configuration for normal operation. Commands are provided to change user-configurable parameters, show the status of the module, and to examine and reset a number of data and error counters. You can reset the PRI software module, but this should not be necessary during normal operation. The PRI software module requires configuration for E1 and T1 interfaces.

To display the status of the PRI, enter the command:

```
SHOW PRI STATE
```

To show the higher layer modules (if any) that are attached to the PRI interface, enter the command:

```
SHOW PRI CONFIGURATION
```

For more information about configuring PRI, see the *Integrated Services Digital Network (ISDN)* chapter in the *AR400 Series Router Software Reference.*

Default Setup

The standard LAPD configurations are shown in Table 9 on page 54 (Basic Rate Interfaces) and Table 10 on page 54 (Primary Rate Interfaces). These settings suit many situations. However, you can modify these settings as required to suit other network situations (see the *Integrated Services Digital Network (ISDN)* chapter, *AR400 Series Router Software Reference*).

Table 9: Standard LAPD configuration for an ISDN Basic Rate Interface.

Mode	Auto
Debug	Off
TEI	Provided by the network

T, N and k values (for each SAPI):

SAPI	Layer 3	T200	T201	T202	T203	N200	N201	N202	k
0	Q.931 Call Control	10	10	20	100	3	260	3	1
1	Q.931 Packet Mode	10	10	20	100	3	260	3	3
16	X.25 Packet Mode	10	10	20	100	3	1024	3	3
63	LAPD Management	10	10	20	100	3	260	3	1

Table 10: Standard LAPD configuration for an ISDN Primary Rate Interface.

Mode	nonAuto
Debug	Off
TEI	0

T, N and k values (for each SAPI):

SAPI	Layer 3	T200	T201	T202	T203	N200	N201	N202	k
0	Q.931 Call Control	10	N/A	N/A	100	3	260	N/A	7
1	Q.931 Packet Mode	10	N/A	N/A	100	3	260	N/A	7
16	X.25 Packet Mode	10	N/A	N/A	100	3	1024	N/A	7
63	LAPD Management	10	N/A	N/A	100	3	260	N/A	7

Testing the BRI or PRI PIC

To test the ISDN PRI, BRI (U), or BRI (S/T) PIC you need to configure a routing protocol such as IP or IPX to use ISDN.

For more information about configuring ISDN calls and routing protocols, see "*Configuring ISDN*" on page 55, "*Configuring an IP Network*" on page 63, and "*Configuring a Novell IPX Network*" on page 75.

Configuring ISDN

This section describes how to configure ISDN on an ISDN expansion option on your router using the command line interface. If you want to use ISDN, your router must have a PIC bay with the appropriate ISDN Port Interface Card installed. Simple ISDN configurations for Basic Rate ISDN, Primary Rate ISDN, ISDN Dial on Demand and ISDN Bandwidth on Demand are described.

ISDN on the router requires minimal user configuration, other than selecting a territory, creating call definitions and configuring the Point-to-Point Protocol (PPP) to use the ISDN calls. The lower layers of the ISDN protocol stack (BRI, LAPD and Q.931) are automatically configured when the router starts up.

The factory default hardware and software settings described here are correct for European Union (EU) countries. For other countries, contact your authorised distributor or reseller for details of local requirements.

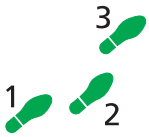
Ordering ISDN in the USA and Canada

In the United States and Canada, Basic Rate ISDN is provided using National ISDN-1, 5ESS or DMS-100 formats, all of which are supported by the router. If National ISDN-1 is available, you can select from a list of "Capability Packages", each providing different features. Contact your ISDN service provider for more information. The router will accept either one or two Service Profile Identifiers (SPIDs).

Configuring Basic Rate ISDN

To connect an AR400 Series router with an AT-AR021(U) PIC installed to a Basic Rate ISDN service the following steps are required:

1. Check BRI hardware configuration.
2. Select country or territory.
3. Set directory numbers and subaddresses (outside USA).
4. Set switch type and SPIDs (USA only).
5. Create call definitions.
6. Create PPP interfaces.



To configure Basic Rate ISDN follow these steps

1. Check BRI hardware configuration

Check that the AT-AR021(U) PIC has the correct termination for the local conditions. The AR410 router can only operate in TE mode and is shipped with the standard 100W termination jumpers removed. This is appropriate for most situations, where the building wiring provides the ISDN termination. Your authorised distributor or reseller can advise you whether or not you should install termination jumpers.

2. Select country or territory.

To select the country in which the router is operated, enter the command:

```
SET SYSTEM TERRITORY={AUSTRALIA|CHINA|EUROPE|JAPAN|KOREA|
    NEWZEALAND|USA}
```

The territory determines which Q.931 profile is used on the ISDN interface. For example, to select the Q.931 profile for the United States, enter the command:

```
SET SYSTEM TERRITORY=USA
```

If you are not sure which territory to use, contact your authorised distributor or reseller. Failure to select the correct territory will invalidate the approval of this product with respect to the applicable national standards for the country in which the product is used.

For installations in the USA, go to step 4. For installations in other countries, go to step 3.

3. Set directory numbers and subaddresses (outside USA).

In countries other than the USA, set router's ISDN directory numbers and subaddresses with the command:

```
SET Q931=0 NUM1=number NUM2=number SUB1=subaddress
    SUB2=subaddress
```

This step is only required if the router is sharing the ISDN S/T bus with other ISDN devices. See the *AR400 Series Router Software Reference* for more information.

Go to Step 5.

4. Set switch type and SPIDs (USA only).

In the USA, you may need to set the ISDN switch type and SPIDs values. Setting the system territory to USA automatically sets the ISDN switch type to National ISDN-1. This should be correct for all new ISDN installations. If the router is connected to another switch type, set the switch type with the command:

```
SET Q931=0 PROFILE=DMS-100
```

for a Northern Telecom DMS-100 switch running custom software, or:

```
SET Q931=0 PROFILE=5ESS
```

for a Lucent 5ESS switch running custom software.

If the switch type is not National ISDN-1, enter the SPIDs (supplied by the ISDN service provider) with the command:

```
SET Q931=0 SPID1=spid SPID2=spid
```

If the switch type is National ISDN-1 the router will, when first turned on, attempt to obtain the SPIDs itself from the switch using the Auto SPID procedures. To monitor the success of this procedure, enter the command:

```
SHOW Q931=0 SPID
```

If the Auto SPID procedure succeeds the router will either select the SPID values to use by itself, or tell the user (in the output of the SHOW Q931=0 SPID command) how to select the SPID values.

If the Auto SPID procedures fail, manually enter the SPIDs with the command:

```
SET Q931=0 SPID1=spid SPID2=spid
```

Enter directory numbers and subaddresses with the command:

```
SET Q931=0 NUM1=number NUM2=number SUB1=subaddress
   SUB2=subaddress
```

The ISDN service provider must supply the directory numbers and subaddresses. If the directory number is a full 10 digit number (3 digit area code plus 7 digit number), the router will append the digits "0101" to the number and attempt SPID initialisation with the result. This is known as the Generic SPID procedure. If SPID initialisation has already taken place and SPIDs obtained through the Auto SPID procedure, then either these SPIDs are the same as the Generic SPID and the router will successfully reinitialise, or the SPIDs are not the same as the Generic SPID and the router will not initialise. In this case, the router will revert to using the Auto SPID values.

5. Create call definitions.

Create ISDN call definitions to enable the router to make ISDN calls to other devices on the ISDN network. This is the only step you must complete to configure ISDN on the router. Before a call can be made from one router to another, create call definitions on both routers, by entering the command:

```
ADD ISDN CALL=name NUMBER=number PRECEDENCE={IN|OUT}
   options...
```

For example, a Remote Office router is to be connected to the Head Office router via ISDN. The ISDN number of the Remote Office router is 1234567. The ISDN number of the Head Office router is 9876543. The called party subaddress information element (IE) is used to carry connection information, and PPP interfaces are created explicitly to use the ISDN calls. Either router can initiate the call, but calls from the Remote Office have precedence. On the Head Office router, to create a call to the Remote Office router, enter the command:

```
ADD ISDN CALL=ROHO OUTSUB=LOCAL SEARCHSUB=LOCAL
   NUMBER=1234567 PREC=IN
```

On the Remote Office router, to create a call to the Head Office router, enter the command:

```
ADD ISDN CALL=ROHO OUTSUB=LOCAL SEARCHSUB=LOCAL
   NUMBER=9876543 PREC=OUT
```

Each call has the same name (ROHO), and this name is passed via the called subaddress IE to provide identification to the remote end of the link. Each router will search for this call using the called subaddress IE.

You must set the precedence to ensure that in the event of a call collision (the same call made and answered at the same time), one call is completed and other call is cleared. The direction of precedence is not important, but set precedence to IN at one end of the call and OUT at the other end of the call.

The ISDN number is the exact sequence required to reach the remote router from the local router, including STD access codes and area codes. The number may contain only decimal digits. Hyphens and other characters will result in an error.

Check that the ISDN calls are successfully added with the command:

```
SHOW ISDN CALL
```

6. Create PPP interfaces.

Create PPP interfaces to use the ISDN calls. PPP provides the link layer protocol and enables multiple network and transport layer protocols such as IP and Novell® IPX to be carried over the same ISDN link.

For example, on the Head Office router create PPP interface 0 to use the ISDN call ROHO, by entering the command:

```
CREATE PPP=0 OVER=ISDN-ROHO
```

On the Remote Office router, create PPP interface 0 to use the ISDN call ROHO, by entering the command:

```
CREATE PPP=0 OVER=ISDN-ROHO
```

Check the configuration with the commands:

```
SHOW ISDN CALL
```

```
SHOW PPP
```

The call ROHO should appear in the output of the SHOW ISDN CALL command. The output of the SHOW PPP command should show interface ppp0 over ISDN-ROHO.

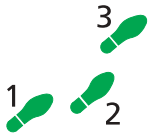
ISDN is now ready for use by routing protocols such as IP and IPX.

Configuring Primary Rate ISDN

Your AR400 Series router can operate in either TE or NT mode, using 75W or 120W termination. The router is shipped with jumpers set to TE mode, 75W termination, Tx grounded and Rx grounded via a 100nF capacitor. This is appropriate for most situations. Your authorised distributor or reseller can advise you whether or not to install grounding jumpers.

The following steps are required:

1. Check BRI hardware configuration.
1. Select the territory.
2. Set directory numbers and subaddresses.
3. Create call definitions.
4. Create PPP interfaces.



To configure Primary Rate ISDN follow these steps

1. Check BRI hardware configuration

Check that the AT-AR021(U) PIC has the correct termination for the local conditions. The AR410 router can only operate in TE mode and is shipped with the standard 100W termination jumpers removed. This is appropriate for most situations, where the building wiring provides the ISDN termination. Your authorised distributor or reseller can advise you whether or not you should install termination jumpers.

2. Select the territory.

To select the country or region in which the router is operated, enter the command:

```
SET SYSTEM TERRITORY={AUSTRALIA|CHINA|
   EUROPE|JAPAN|KOREA|NEWZEALAND|USA}
```

The territory determines which Q.931 profile is used on the ISDN interface. For example, to select the Q.931 profile for New Zealand, enter the command:

```
SET SYSTEM TERRITORY=NEWZEALAND
```

If you are not sure which territory to use, contact your authorised distributor or reseller. Failure to select the correct territory will invalidate the approval of this product with respect to the applicable national standards for the country in which the product is used.

3. Set directory numbers and subaddresses.

The router's ISDN directory numbers and subaddresses are set with the command:

```
SET Q931=0 NUM1=number NUM2=number SUB1=subaddress
   SUB2=subaddress
```

This step is only required if the router is sharing the ISDN S/T bus with other ISDN devices. See the *AR400 Series Router Software Reference* for more information.

4. Create call definitions.

Create ISDN call definitions to enable the router to make ISDN calls to other devices on the ISDN network. This is the only step you must complete to configure ISDN on the router. Before a call can be made from one router to another, create call definitions on both routers, by entering the command:

```
ADD ISDN CALL=name NUMBER=number PRECEDENCE={IN|OUT}
   options...
```

For example, a Remote Office router is to be connected to the Head Office router via ISDN. The ISDN number of the Remote Office router is 1234567. The ISDN number of the Head Office router is 9876543. The called party subaddress information element (IE) is used to carry connection information, and PPP interfaces are created explicitly to use the ISDN calls. Either router can initiate the call, but calls from the Remote Office have precedence. On the Head Office router, to create a call to the Remote Office router, enter the command:

```
ADD ISDN CALL=ROHO OUTSUB=LOCAL SEARCHSUB=LOCAL
   NUMBER=1234567 PREC=IN
```

On the Remote Office router, to create a call to the Head Office router, enter the command:

```
ADD ISDN CALL=ROHO OUTSUB=LOCAL SEARCHSUB=LOCAL
   NUMBER=9876543 PREC=OUT
```

Each call has the same name (ROHO), and this name is passed via the called subaddress IE to provide identification to the remote end of the link. Each router will search for this call using the called subaddress IE.

You must set the precedence to ensure that in the event of a call collision (the same call made and answered at the same time), one call is completed and other call is cleared. The direction of precedence is not important, but set precedence to IN at one end of the call and OUT at the other end of the call.

The ISDN number is the exact sequence required to reach the remote router from the local router, including STD access codes and area codes. The

number may contain only decimal digits. Hyphens and other characters will result in an error.

Check that the ISDN calls are successfully added with the command:

```
SHOW ISDN CALL
```

5. Create PPP interfaces.

Create PPP interfaces to use the ISDN calls. PPP provides the link layer protocol and enables multiple network and transport layer protocols such as IP and Novell® IPX to be carried over the same ISDN link.

For example, on the Head Office router create PPP interface 0 to use the ISDN call ROHO by entering the command:

```
CREATE PPP=0 OVER=ISDN-ROHO
```

On the Remote Office router, create PPP interface 0 to use the ISDN call ROHO by entering the command:

```
CREATE PPP=0 OVER=ISDN-ROHO
```

Check the configuration with the commands:

```
SHOW ISDN CALL
```

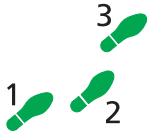
```
SHOW PPP
```

The call ROHO should appear in the output of the SHOW ISDN CALL command. The output of the SHOW PPP command should show interface ppp0 over ISDN-ROHO.

ISDN is now ready for use by routing protocols such as IP and IPX.

Configuring ISDN Dial on Demand

A PPP interface that uses an ISDN call as its physical interface can be configured for dial-on-demand operation. The ISDN call is activated only when data is transmitted, and is disconnected when the link is idle for a period of time.



To configure ISDN dial-on-demand follow these steps

The following steps are required:

1. Configure BRI or PRI ISDN.
2. Create PPP interfaces.

1. Configure BRI or PRI ISDN.

Complete steps 1 to 5 of "*Configuring Basic Rate ISDN*" on page 55, or steps 1 to 4 of "*Configuring Primary Rate ISDN*" on page 58.

2. Create PPP interfaces.

Create PPP interfaces to use the ISDN calls and enable the IDLE timer. Using the example in step 6 of "*Configuring Basic Rate ISDN*" on page 55, on the Head Office router create PPP interface 0 to use the ISDN call ROHO, enter the command:

```
CREATE PPP=0 OVER=ISDN-ROHO IDLE=ON
```

On the Remote Office router, to create PPP interface 0 to use the ISDN call ROHO, enter the command:

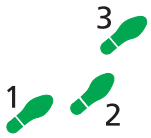
```
CREATE PPP=0 OVER=ISDN-ROHO IDLE=ON
```

Setting the IDLE parameter to ON enables the idle timer and sets the timeout period to 60 seconds. ISDN calls are disconnected no data is transmitted over the link for 60 seconds. To enable the idle timer with a different timeout period, specify a time in seconds instead of the value ON.

PPP interface 0 is now configured for dial-on-demand operation and any routing protocols such as IP and IPX that are configured to use PPP interface 0 will automatically inherit the dial-on-demand functionality.

Configuring ISDN Bandwidth on Demand

You can configure a PPP interface to use up to two B channels on an ISDN Basic Rate interface to provide bandwidth on demand. PPP activates additional ISDN channels when the bandwidth exceeds an upper threshold, and deactivates ISDN channels as bandwidth falls below a lower threshold.



To configure an ISDN connection for bandwidth on demand follow these steps

The following steps are required:

1. Configure BRI or PRI ISDN.
2. Create a second ISDN call.
3. Create PPP interfaces.

1. Configure BRI or PRI ISDN.

Complete steps 1 to 5 of "*Configuring Basic Rate ISDN*" on page 55, or steps 1 to 4 of "*Configuring Primary Rate ISDN*" on page 58.

2. Create a second ISDN call.

Create a second ISDN call on each router, identical to the call ROHO but with the name DEMAND.

3. Create PPP interfaces.

Create PPP interfaces to use the ISDN calls, enable the IDLE timer and add a second demand channel. Using the example in step 6 of "*Configuring Basic Rate ISDN*" on page 55, on the Head Office router create PPP interface 0, enter the command:

```
CREATE PPP=0 OVER=ISDN-ROHO IDLE=ON

ADD PPP=0 OVER=ISDN-DEMAND TYPE=DEMAND
```

On the Remote Office router, to create PPP interface 0, enter the command:

```
CREATE PPP=0 OVER=ISDN-ROHO IDLE=ON

ADD PPP=0 OVER=ISDN-DEMAND TYPE=DEMAND
```

PPP interface 0 is now configured for bandwidth on demand operation and any routing protocols such as IP and IPX that are configured to use PPP interface 0 will automatically inherit the bandwidth on demand functionality.

For more information about ISDN, including LAPD, Q.931, Call control, Call Logging, DNS, AODI, X.25 and Data over voice, see the *Integrated Services Digital Network (ISDN)* chapter in the *AR400 Series Router Software Reference*.

Installing Port Interface Cards (PICs)

Port Interface Cards (PICs) provide you with a cost effective and flexible way to add new or additional network interfaces to your router. If you add or change PICs, you can upgrade network interface capability without having to replace the router.

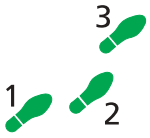
For information about what PICs are available for your AR400 Series router, see the *AR Series Router Hardware Reference.*

For information about installing a PIC see the *Port Interface Card Quick Install Guide*.

For detailed information about PIC hardware see the *Port Interface Card Hardware Reference*.

Connecting to a Leased Line Circuit

Leased lines are a commonly used for building Wide Area Networks (WANs). A leased line maybe the right solution if you need to connect distant sites across public areas. By installing an AT-AR023 SYN PIC in your AR400 Series router this option is available to you.



To connect your AR400 Series router with an AT-AR023 SYN PIC installed to a synchronous leased line circuit, follow these steps

The following steps are required:

1. Follow the instructions in the *Port Interface Card Quick Install Guide* on how to install the AT-AR023 SYN PIC.
2. Use the appropriate approved transition cable (RS-232, X.21 or V.35), to connect the synchronous port on the rear panel of the AT-AR023 SYN PIC to the telecommunication service provider's NTU.
3. To check the configuration of the port, enter the command:

   ```
   SHOW SYN=n
   ```

   where *n* is the synchronous port number. Verify that the information displayed is correct. In particular, you should set "State" to "enabled" and "Interface type" should match the transition cable used.
4. Configure a data link layer module, such as PPP (Point-to-Point Protocol), Frame Relay or X.25 LAPB, to use the synchronous interface. To create a PPP interface 0 to use synchronous port 0, enter the command:

   ```
   CREATE PPP=0 OVER=SYN0
   ```
5. To check the configuration, enter the commands:

   ```
   SHOW SYN=0
   ```

   ```
   SHOW PPP=0
   ```

   The output of the SHOW SYN command should show "Active" set to "yes" and "Module" set to "ppp". The output of the SHOW PPP command should show interface ppp0 over syn0 with "LCP" as the control protocol. The Tx and Rx LEDs are lit as data is sent and received on the interface.

Chapter 5

Routing

This Chapter

This chapter introduces some protocols supported by the router, including:

- Internet Protocol (IP) (see "*Configuring an IP Network*" on page 63).
- IP Multicasting (see "*Configuring IP Multicasting*" on page 67).
- Configuring Dynamic Host Configuration Protocol (see "*Configuring Dynamic Host Configuration Protocol (DHCP)*" on page 73.)
- Novell IPX (see "*Configuring a Novell IPX Network*" on page 75).
- IPX Dial-on-Demand (see "*Configuring IPX Dial-on-Demand*" on page 79).
- AppleTalk (see "*AppleTalk*" on page 82).
- Routing Information Protocol (RIP) (see "*Routing Information Protocol (RIP)*" on page 83).
- Resource Reservation Protocol (RSVP) (see "*Resource Reservation Protocol (RSVP)*" on page 83).
- OSPF (see "*OSPF*" on page 84).

For a complete description of all protocols supported by the router, see the *AR400 Series Router Software Reference*.

Configuring an IP Network

TCP/IP is the most widely used network protocol. The Internet uses TCP/IP for routing all its traffic. TCP/IP provides a range of services including remote login, Telnet, file transfer (FTP), Email and access to the World-Wide Web.

The AR400 Series routers route TCP/IP packets between switch ports in separate VLANs, and across the Wide Area Network using services like ISDN, Frame Relay and leased lines. This enables you to join remote TCP/IP LANs together as a single internet to exchange information.

Before You Start

1. Ensure that the routers you want to configure are connected as described in the *AR400 Series Router Quick Install Guide*.
2. Connect a terminal to the console port (port 0) on each router as described in the in the *AR400 Series Router Quick Install Guide*. Alternatively, you can connect a PC to the console port and use a terminal emulation program like Windows™ Terminal.
3. Login to the MANAGER account on each router (see "*Logging In*" on page 15).

Configuring IP

This example (Figure 5 on page 64) illustrates the steps required to configure TCP/IP using the router's command line interface. Two routers running TCP/IP will be connected together using the Point-to-Point Protocol (PPP) over a wide area link. Each router is associated with a VLAN.

Figure 5: Example configuration for an IP network.

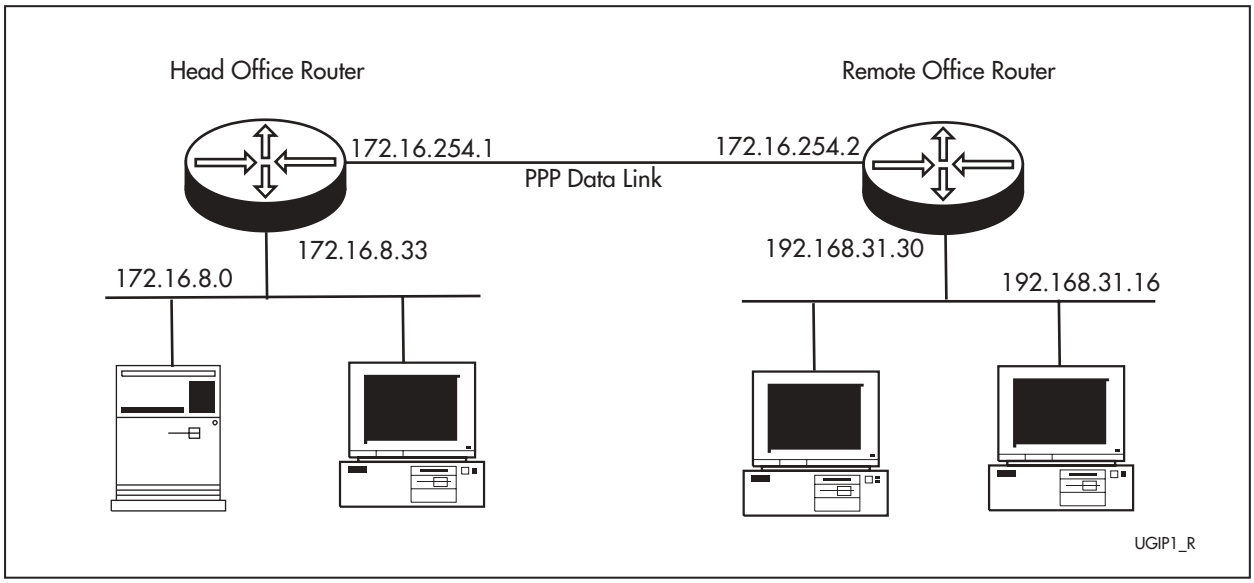
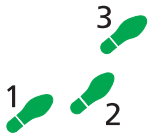


Table 11: Example configuration parameters for an IP network .

Parameter	Head Office Router	Remote Office Router
VLAN interface	vlan2	vlan3
Ports (untagged)	Ports 2-7	Ports 1-3
VLAN interface IP address	172.16.8.33	192.168.31.30
VLAN IP subnet address	172.16.8.0	192.168.31.16
Ethernet LAN IP subnet mask	255.255.255.0	255.255.255.240
PPP interface	ppp0	ppp0
PPP interface IP address	172.16.254.1	172.16.254.2
PPP interface IP subnet address	172.16.254.0	172.16.254.1
PPP interface IP subnet mask	255.255.255.0	255.255.255.0



To configure IP follow these steps

The following steps are required:

1. Configure the PPP Link.
2. Create a VLAN and add untagged ports.
3. Configure the IP routing module on both routers.
4. Test the configuration.
5. Save the configuration.

1. Configure the PPP Link

Refer to other sections of this guide on how to configure PPP interface 0 on each router to use the wide area link.

- See "*Point to Point Protocol (PPP)*" on page 49 for information about configuring PPP to use a synchronous link.
- See "*Configuring ISDN*" on page 55 for information about configuring PPP to use an ISDN call.
- If the PPP interface is configured for dial-on-demand operation (see"*Configuring ISDN Dial on Demand*" on page 60) or bandwidth on demand operation (see "*Configuring ISDN Bandwidth on Demand*" on page 61), these services are automatically used by the IP routing software.

2. Create VLANs and add untagged ports

Each new VLAN is created with a VLAN name that is unique in the router, and a VLAN Identifier (VID) that uniquely identifies the VLAN on the physical LAN. If the VLAN name begins with "vlan" and ends in a number then the number must be the same as the VID specified. To create VLANs, enter the command:

```
CREATE VLAN=vlanname VID=2..4094
```

In this example two VLANs are created by entering the commands:

```
CREATE VLAN=vlan2 VID=2
CREATE VLAN=vlan3 VID=3
```

To add untagged ports to vlan2, enter the command:

```
ADD VLAN=vlan2 PORT=2-7
```

To add untagged ports to vlan3, enter the command:

```
ADD VLAN=vlan3 PORT=1-3
```

See the *Switching* chapter in the *AR400 Series Router Software Reference* for more detailed information about creating VLANs and VLAN ports.

3. Configure IP Routing

To clear any pre-existing IP configuration and turn on the IP routing software on each router, enter the commands:

```
PURGE IP
ENABLE IP
```

On the Head Office router define two IP interfaces, one for the VLAN and one for the wide area link:

```
ADD IP INT=VLAN2 IP=172.16.8.33 MASK=255.255.255.0
ADD IP INT=PPP0 IP=172.16.254.1 MASK=255.255.255.0
```

Repeat this procedure on the Remote Office router, defining one IP interface for the VLAN and one for the wide area link:

```
ADD IP INT=VLAN3 IP=192.168.31.30 MASK=255.255.255.240
```

```
ADD IP INT=PPP0 IP=172.16.254.2 MASK=255.255.255.0
```

A routing protocol, such as RIP, can be enabled so that the routers can exchange information about routes to all of the IP devices (hosts, PCs, file servers, etc.) on the internet. However, on a dial-on-demand ISDN connection this may result in excessive call charges. So for this example static routes are defined. On the Head Office router enter the command:

```
ADD IP ROUTE=192.168.31.0 MASK=255.255.255.240 INT=PPP0
   NEXT=172.16.254.2
```

Repeat this procedure for the Remote Office router, entering the command:

```
ADD IP ROUTE=172.16.8.0 MASK=255.255.255.0 INT=PPP0
   NEXT=172.16.254.1
```

The IP routing software is now configured and operational on both routers.

4. Test the configuration.

Check the IP configuration using the following commands and then functionally test the configuration by establishing a Telnet (remote access) connection to the remote router.

To check the routes, enter the command (on either router):

```
SHOW IP ROUTE
```

For each router, there should be a route to the LAN and PPP interfaces on the local router and a route to the LAN interface on the remote router.

Test the PPP link between the two routers using the PING command on each router to send ping packets to the router at the remote end of the PPP link. On the Head Office router, enter the command:

```
PING 192.168.31.30
```

On the Remote Office router, enter the command:

```
PING 172.16.8.33
```

Within a few seconds the router will display a message like:

```
Echo reply 1 from 172.16.8.33 time delay 20 ms
```

indicating a response was received from the router at the remote end of the PPP link.

To functionally test the connection between the two routers, use Telnet to establish a connection to the remote router. Enter the following command on the Head Office router to connect to the Remote Office router:

```
TELNET 192.168.31.30
```

You will see the login screen for the Remote Office router. To connect from the Remote Office router to the Head Office router, on the Remote Office router, enter the command:

```
TELNET 172.16.8.33
```

5. Save the configuration

To save the new dynamic configuration as a script, enter the command:

```
CREATE CONFIG=IPCONF.SCP
```

Configuring IP Multicasting

IP multicasting is used to transmit packets to a group of hosts simultaneously on a TCP/IP network or sub-network. Network bandwidth is saved because files are transmitted as one data stream and are split apart by the router to the target stations at the end of the path.

The multicast environment consists of senders (IP hosts), routers and switches (intermediate forwarding devices) and receivers (IP hosts). Any IP host can send packets to a multicast group, in the same way that they send unicast packets to a particular IP host, by specifying its IP address. A host need not belong to a multicast group in order to send packets to the multicast group. Packets sent to a group address are only received by members of the group.

For multicasting to succeed, the router needs to know which of its interfaces are directly connected to members of each multicast group. To establish this, the router uses Internet Group Management Protocol (IGMP) for multicast group management. IGMP is used between hosts and multicast routers and switches on a single physical network to establish hosts' membership in particular multicast groups.

The router uses this information, in conjunction with a multicast routing protocol, to know which other routers to route multicast traffic to. The router maintains a routing table for multicast traffic with Distance Vector Multicast Routing Protocol (DVMRP), Protocol Independent Multicast-Sparse Mode (PIM-SM), or Protocol Independent Multicast-Dense Mode (PIM-DM). You must configure IGMP and one of the multicast routing protocols before the router can forward multicast packets. DVMRP and PIM-Sparse Mode share a separate multicast forwarding table.

When the router receives a packet addressed to a multicast group, it forwards it to the interfaces that have group members connected to them, according to IGMP, and out other interfaces specified by the multicast routing protocol. Membership in a multicast group is dynamic; hosts can join and leave at any time. Multicast groups can be long or short lived, and can have relatively stable or constantly changing membership. There is no limit on the location or number of members in a multicast group. A host can belong to more than one multicast group at a time.

When the router finds out from IGMP that a new host has joined a multicast group on one of its interfaces, the router needs to receive the multicast traffic for this group, so that it can forward it to the host. The router uses the multicast routing protocol (DVMRP, PIM-SM or PIM-DM) to notify routers closer to the sender (upstream) to forward it traffic for the group.

While you can configure different multicasting protocols on different interfaces on the same router, multicasting information is not translated between the different multicast protocols.

Configuring IGMP

By default, IGMP is disabled on the router and on all interfaces. To enable IGMP on the router, enter the command:

```
ENABLE IP IGMP
```

You must enable IGMP on an interface before the interface can send or receive IGMP messages. If DVMRP is used for multicast routing, you must also enable IGMP on any interfaces used by DVMRP. To enable IGMP on an interface, enter the command:

```
ENABLE IP IGMP INTERFACE=interface
```

IGMP keeps the local group database up to date with current multicast group members by updating it when it hears IGMP Host Membership Reports on an interface. If the router is the IGMP designated router for the subnetwork, it sends out IGMP Host Membership Queries at a Query Interval. If the router does not receive a Host Membership Report for a multicast group on an interface within the Timeout period, it deletes the multicast group from its local group database. The default value of the Query Interval (125 seconds) and of the Timeout (2*(Query Interval + 10) seconds) will suit most networks. You should only change these defaults with caution, and if you have a sound understanding of how they affect interaction with other devices. To change the intervals, enter the command:

```
SET IP IGMP [TIMEOUT=1.65535] [QUERYINTERVAL=1.65535]
```

To display information about IGMP and multicast group membership, enter the command:

```
SHOW IP IGMP
```

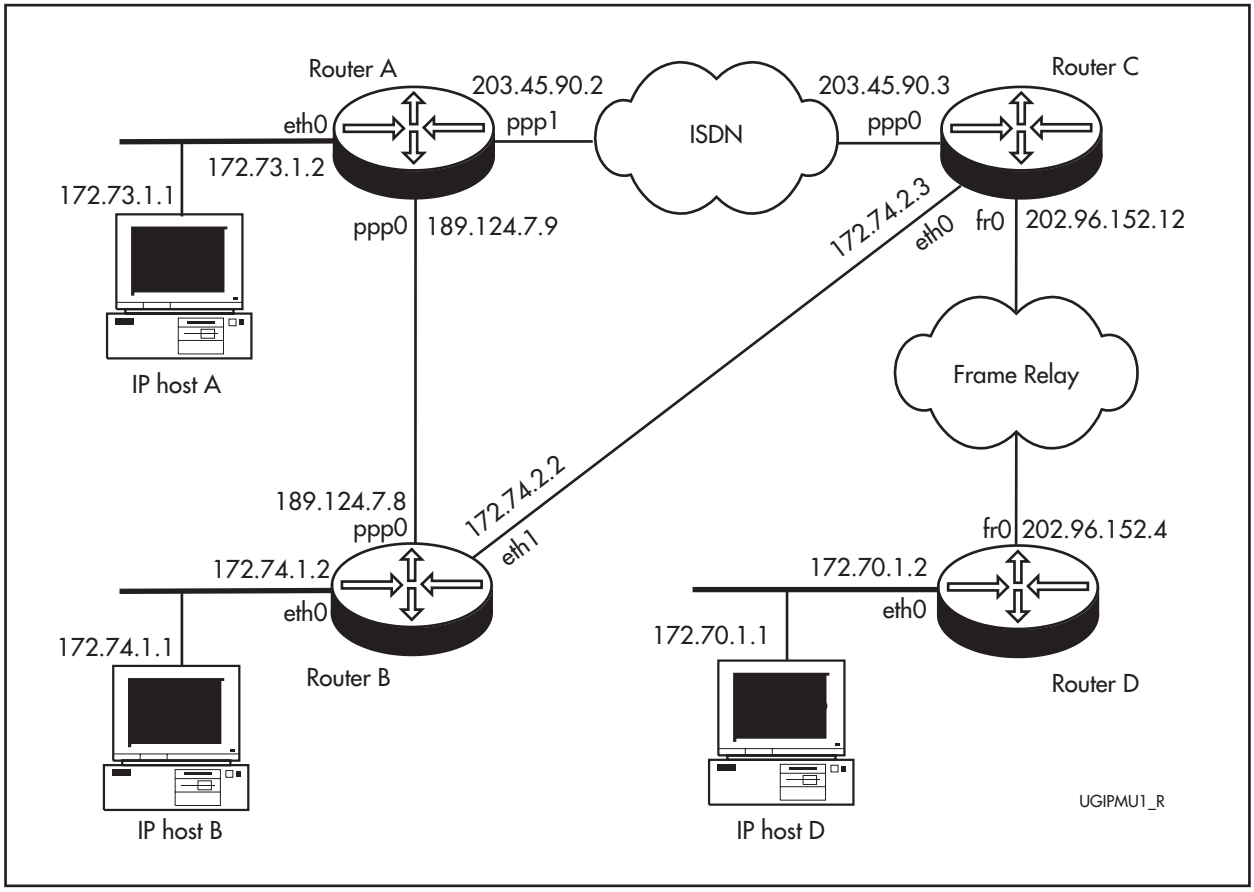
Multicasting using DVMRP

This example (Figure 6 on page 69) allows IP hosts to send data to and receive data from the multicast groups. Multicast group management uses IGMP, and multicast routing between the routers uses DVMRP. The example assumes that each router starts from the default configuration.

Multicast packets are delivered along the shortest path from one host to another. The distance is the sum of metrics along this path. So in this example, the shortest path from IP host A to IP host B is Router A → Router C → Router B. From IP host A to IP host D the shortest path is Router A → Router C → Router D. If IP host B joins the multicast group to which IP host A is a sender, multicast data packets will not be delivered to Router D or IP host D, unless IP host D also joins the same multicast group. Changing the metric on interfaces may change the path by which multicast packets are delivered.

Interfaces with DVMRP enabled must also have IGMP enabled.

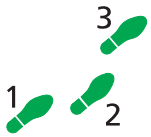
Figure 6: Multicast configuration example using IGMP and DVMRP.



To configure multicast routing using DVMRP follow these steps

The following steps are required:

1. Configure multicast routing using DVMRP on Router A.
2. Configure multicast routing using DVMRP on Router B.
3. Configure multicast routing using DVMRP on Router C.
4. Configure multicast routing using DVMRP on Router D.
5. Confirm multicast routing is working.



Configure multicast routing using DVMRP on Router A.

1. Set the system name.

To set a unique system name for the router, enter the command:

```
SET SYS NAME=A-dvmrp
```

2. Configure ISDN.

To set up an ISDN call to Router C for DVMRP multicast traffic, enter the command:

```
ADD ISDN CALL=DVMRP NUMBER=1234567 PRECEDENCE=OUT
    OUTSUB=LOCAL SEARCHSUB=LOCAL
```

3. **Configure PPP.**

   To create PPP interfaces over a synchronous port and the ISDN call, enter the commands:

```
CREATE PPP=0 OVER=SYN0

CREATE PPP=1 OVER=ISDN-DVMRP IDLE=ON
```

4. **Configure IP.**

   To enable the IP module, and assign IP addresses to the interfaces, enter the commands:

```
ENABLE IP

ADD IP INTERFACE=PPP0 IPADDRESS=189.124.7.9
   MASK=255.255.0.0

ADD IP INTERFACE=PPP1 IPADDRESS=203.45.90.2
   MASK=255.255.255.0

ADD IP INTERFACE=ETH0 IPADDRESS=172.73.1.2
   MASK=255.255.255.0
```

5. **Configure IGMP.**

   To enable IGMP on the router for multicast group management, enter the command:

```
ENABLE IP IGMP
```

   To enable IGMP on the interfaces that have potential multicast receivers (IP hosts) connected to them, and the interfaces using DVMRP, enter the commands:

```
ENABLE IP IGMP INTERFACE=ETH0

ENABLE IP IGMP INTERFACE=PPP0

ENABLE IP IGMP INTERFACE=PPP1
```

6. **Configure DVMRP.**

   To enable DVMRP for multicast routing, enter the command:

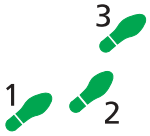
```
ENABLE DVMRP
```

   Enable DVMRP on the interfaces that use DVMRP for multicast routing. Setting the metrics on each of the interfaces influences the path cost and therefore the traffic sent over the interface. (The higher the metric, the higher the path cost, and the lower the traffic over the interface.) Enter the commands:

```
ADD DVMRP INTERFACE=ETH0 METRIC=1

ADD DVMRP INTERFACE=PPP0 METRIC=6

ADD DVMRP INTERFACE=PPP1 METRIC=3
```



Configure multicast routing using DVMRP on Router B.

1. **Set the system name.**

   To set a unique system name for the router, enter the command:

```
SET SYS NAME=B-dvmrp
```

2. **Configure PPP.**

   To create a PPP interface over a synchronous port, enter the command:

```
CREATE PPP=0 OVER=SYN0
```

3. **Configure IP.**

   To enable IP on the router, and assign IP addresses to the interfaces used by DVMRP for multicast routing, enter the commands:

```
ENABLE IP

ADD IP INTERFACE=PPP0 IPADDRESS=189.124.7.8
   MASK=255.255.0.0

ADD IP INTERFACE=ETH0 IPADDRESS=172.74.1.2
   MASK=255.255.255.0

ADD IP INTERFACE=ETH1 IPADDRESS=172.74.2.2
   MASK=255.255.255.0
```

4. **Configure IGMP.**

   To enable IGMP on the router, and on the interfaces that have IP host connected to them, so that the router can maintain its group membership data, enter the commands:

```
ENABLE IP IGMP

ENABLE IP IGMP INTERFACE=PPP0

ENABLE IP IGMP INTERFACE=ETH0

ENABLE IP IGMP INTERFACE=ETH0
```

5. **Configure DVMRP**

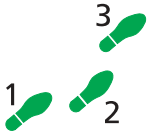
   To enable DVMRP on the router and on each interface over which it is used for multicast routing, enter the commands:

```
ENABLE DVMRP

ADD DVMRP INTERFACE=ETH0 METRIC=1

ADD DVMRP INTERFACE=ETH1 METRIC=1

ADD DVMRP INTERFACE=PPP0 METRIC=6
```



Configure multicast routing using DVMRP on Router C.

1. **Set the system name.**

   To set a unique system name for the router, enter the command:

```
SET SYS NAME=C-dvmrp
```

2. **Configure Frame Relay.**

   To configure a Frame Relay interface over a synchronous port to Router D, and add a data link circuit to the Frame Relay interface, enter the commands:

```
CREATE FRAMERELAY=0 OVER=SYN0 LMISCHEME=NONE

ADD FRAMERELAY=0 DLC=20
```

3. **Configure ISDN.**

   Set up an ISDN call to Router A for DVMRP multicast traffic. This call must have the same name as the ISDN call from Router A, and the opposite precedence. Enter the command:

```
ADD ISDN CALL=DVMRP OUTSUB=LOCAL SEARCHSUB=LOCAL
   PRECEDENCE=IN NUM=7654321
```

4. **Configure PPP.**

   To configure a PPP interface over the ISDN interface, enter the command:

   ```
   CREATE PPP=0 OVER=ISDN-DVMRP IDLE=ON
   ```

5. **Configure IP.**

   To enable the IP module, and assign IP addresses to the interfaces, enter the commands:

   ```
   ENABLE IP

   ADD IP INTERFACE=FR0 IPADDRESS=202.96.152.12
      MASK=255.255.255.0

   ADD IP INTERFACE=PPP0 IPADDRESS=203.45.90.3
      MASK=255.255.255.0

   ADD IP INTERFACE=ETH0 IPADDRESS=172.74.2.3
      MASK=255.255.255.0
   ```

6. **Configure IGMP.**

   To enable IGMP on the router and on the interfaces over which group membership is to be managed, enter the commands:

   ```
   ENABLE IP IGMP

   ENABLE IP IGMP INTERFACE=ETH0

   ENABLE IP IGMP INTERFACE=PPP0

   ENABLE IP IGMP INTERFACE=FR0
   ```

7. **Configure DVMRP.**

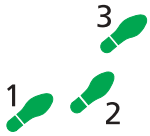
   Enable DVMRP on the router, and assign the interfaces over which DVMRP will perform multicast routing. Enter the commands:

   ```
   ENABLE DVMRP

   ADD DVMRP INTERFACE=ETH0 METRIC=1

   ADD DVMRP INTERFACE=PPP0 METRIC=3

   ADD DVMRP INTERFACE=FR0 DLC=20 METRIC=6
   ```



Configure multicast routing using DVMRP on Router D.

1. **Set the system name.**

   To set a unique system name for the router, enter the command:

   ```
   SET SYS NAME=D-dvmrp
   ```

2. **Configure Frame Relay.**

   To create a Frame Relay interface over a synchronous port to Router C, and add a data link circuit to the Frame Relay interface, enter the command:

   ```
   CREATE FR=0 OVER=SYN0 LMI=NONE

   ADD FR=0 DLC=20
   ```

3. **Configure IP.**

   To enable IP, and assign IP addresses to the interfaces, enter the commands:

   ```
   ENABLE IP

   ADD IP INTERFACE=ETH0 IP=172.70.1.2 MASK=255.255.255.0

   ADD IP INTERFACE=FR0 IP=202.96.152.4 MASK=255.255.255.0
   ```

4. **Configure IGMP.**

   To enable IGMP on the router, and on the interfaces over which group membership will be managed, enter the commands:

   ```
   ENABLE IP IGMP
   ENABLE IP IGMP INTERFACE=ETH0
   ENABLE IP IGMP INTERFACE=FR0
   ```

5. **Configure DVMRP.**

   To enable DVMRP on the router, and on the interfaces over which DVMRP will perform multicast routing, enter the commands:

   ```
   ENABLE DVMRP
   ADD DVMRP INTERFACE=ETH0 METRIC=1
   ADD DVMRP INTERFACE=FR0 DLC=20 METRIC=6
   ```

Confirm multicasting.

When you have configured the three routers, the IP hosts connected to these interfaces can send and receive multicasts packets.

1. **Test multicasting.**

   Send IP multicast data between hosts connected to each of the routers to test whether IP multicasting is successful.

2. **Check the configuration.**

   To check the configuration on each router, use the commands:

   ```
   SHOW DVMRP
   SHOW IP IGMP
   SHOW IP ROUTE MULTICAST
   ```

For more information on how to configure IP Multicasting, including PIM-SM and PIM-DM, see the *IP Multicasting* chapter in the *AR400 Series Router Software Reference*.

Configuring Dynamic Host Configuration Protocol (DHCP)

The Dynamic Host Configuration Protocol (DHCP) provides a method for passing configuration information to hosts on a TCP/IP network. DHCP is based on a client–server model, where the server is the host that allocates network addresses and initialisation parameters, and the client is the host that requests these parameters from the server.

DHCP supports three mechanisms for IP address allocation. These mechanisms are:

- the *automatic allocation* mechanism, where DHCP assigns a permanent IP address to a host.
- the *dynamic allocation* mechanism, where DHCP assigns an IP address to a host for a limited period of time, or until the host explicitly relinquishes the address.

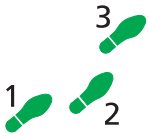
- the *manual allocation* mechanism, where a host's IP address is assigned by the network administrator, and DHCP is used simply to convey the assigned address to the host.

A particular network will use one or more of these mechanisms, depending on the policies of the network administrator.

DHCP is based on its predecessor, Bootstrap Protocol (BOOTP), but adds automatic allocation of reusable network addresses and additional configuration options. This software implementation supports both DHCP and its predecessor BOOTP, but you must explicitly enable this support by a manager command. BOOTP requests are only satisfied by policies with leases set to INFINITY, i.e. using the automatic allocation mechanism.

Configuring DHCP

This example illustrates how to configure your router to act as a DHCP server in a small site. The site has a limited range of IP addresses and the users only use IP for short periods of time. The dynamic DHCP mechanism is the most appropriate for this situation. The router on the LAN will be configured to provide DHCP services to the PCs on the local LAN.



To configure DHCP follow these steps

The following steps are required:

1. Enable the DHCP Server.
2. Create a policy.
3. Create a range.
4. Test the configuration.
5. Configure a printer.

1. Enable the DHCP Server.

To enable DHCP, enter the command:

```
ENABLE DHCP
```

2. Create a policy.

To create a policy setting the base configuration information required by the client hosts, enter the commands:

```
CREATE DHCP POLICY=base LEASE=7200
ADD DHCP POLICY=base SUBNET=255.255.255.0
ADD DHCP POLICY=base ROUTER=192.168.1.1
ADD DHCP POLICY=base DNSSERVER=192.168.1.254,
   192.168.1.253
```

3. Create a range.

To create a range the defines the list of IP address to which the policy applies, enter the command:

```
CREATE DHCP RANGE=office POLICY=base IP=192.168.1.16
   NUMBER=32
```

4. **Test the configuration.**

   To check that DHCP functions correctly, enter the commands:

   ```
   SHOW DHCP
   SHOW DHCP POLICY
   SHOW DHCP RANGE
   SHOW DHCP CLIENT
   ```

5. **Configure a printer.**

   To configure a printer with the MAC address of 00-00-0c-00-28-73 that only talks BOOTP, enter the commands:

   ```
   ENABLE DHCP BOOTP
   CREATE DHCP POLICY=prnt LEASE=INFINITY INHERIT=base
   ADD DHCP RANGE=office POLICY=prnt IP=192.168.1.31
      ADDRESS=00-00-0c-00-28-73
   ```

For more information on how to configure DHCP, see the *Dynamic Host Configuration Protocol* (DHCP) chapter in the *AR400 Series Router Software Reference*.

Configuring a Novell IPX Network

The router's implementation of the Novell IPX protocol uses the term *circuit* to refer to a logical connection over an *interface*, similar to an X.25 permanent virtual circuit (PVC) or a Frame Relay Data Link Connection (DLC). The term *interface* refers to the underlying physical interface, such as VLAN, Ethernet, Point-to-Point (PPP) and Frame Relay.

Before You Start

1. Collect the information that you will need to configure IPX. Pay particular attention to the following points:

   - Each network in a Novell internet, including all LANs and WAN links, must be assigned a network number. Novell file servers also have an internal network number. These network numbers must be unique across the Novell internet—no two networks or file servers may use the same network number. All devices attached to a network must use the same network number to refer to the network. Check to see what numbers your file servers are using. Many schemes exist to ensure that numbers are kept unique, for example, using the hexadecimal representation of the IP address or the telephone number of each location.
   - All routers, file servers and workstations attached to an Ethernet LAN must use the same Ethernet encapsulation or frame type. Table 12 on page 76 lists the Novell frame type and the equivalent AR router encapsulation. You can determine the file server name, internal network number, Ethernet frame type and Ethernet network number used by a Novell file server, by interrogating the file server itself. From the management console attached to the Novell file server, at the system console prompt type the command "config" and record the values of the fields "File server name", "IPX internal network number", "Frame type" and "LAN protocol". You can also access the system console by running the console utility from any workstation logged in as supervisor. For more details, contact your local Novell network administrator or refer to the Novell documentation.

Table 12: Frame type and equivalent router encapsulation.

Novell Frame Type	Router Encapsulation
Ethernet_802.3	802.3
Ethernet_802.2	802.2
Ethernet_II	EthII
Ethernet_SNAP	SNAP

2. Ensure that the routers you want to configure are connected as described in the *AR400 Series Router Quick Install Guide*.
3. Connect a terminal to the console port (port 0) on each router as described in the in the *AR400 Series Router Quick Install Guide*. Alternatively, you can connect a PC to the console port and use a terminal emulation program like Windows™ Terminal.
4. Login to the MANAGER account on each router. (see "*Logging In*" on page 15)

Configuring IPX

This example (Figure 7 on page 76) illustrates the steps required to configure a pair of AR410 routers to create a Novell® IPX internetwork, using the router's command line interface. In this scenario, PCs at a remote office need access to a Novell file server at the Head Office site. The two sites are connected by a PPP link over a wide area link—either a dedicated leased line or an ISDN call.

Figure 7: Example configuration for an IPX network.

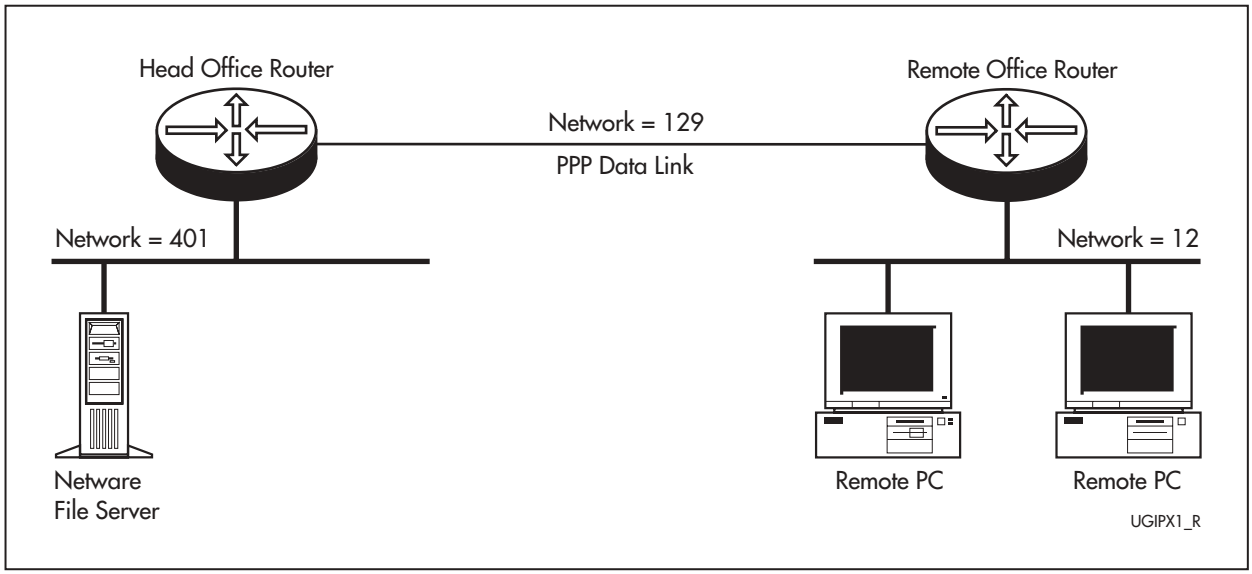
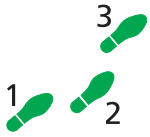


Table 13: Example configuration parameters for an IPX network .

Configuration Parameter	Head Office Router	Remote Office Router
Ethernet interface	eth0	eth0
Ethernet encapsulation	802.3	802.3
Novell network number for Ethernet	401	12
IPX circuit over Ethernet	1	1

Table 13: Example configuration parameters for an IPX network (Continued).

Configuration Parameter	Head Office Router	Remote Office Router
PPP interface	ppp0	ppp0
Novell network number for PPP	129	129
IPX circuit over PPP	2	2



To configure IPX follow these steps

The following steps are required:

1. Configure the PPP link.
2. Configure the routers for IPX.
3. Test the configuration.
4. Save the configuration.

1. Configure the PPP Link

Refer to other sections of this guide on how to configure PPP interface 0 on each router to use the wide area link.

- See "*Point to Point Protocol (PPP)*" on page 49 for information about configuring PPP to use a synchronous link.
- See "*Configuring ISDN*" on page 55 for information about configuring PPP to use an ISDN call.
- If the PPP interface is configured for dial-on-demand operation (see "*Configuring ISDN Dial on Demand*" on page 60) or bandwidth on demand operation (see "*Configuring ISDN Bandwidth on Demand*" on page 61), these services are automatically used by the IPX routing software.

2. Configure IPX Routing

To purge the IPX static database to clear any pre-existing IPX configuration and enable the IPX routing software on each router, enter the commands:

```
PURGE IPX

ENABLE IPX
```

On the Head Office router define two IPX circuits, one for the Ethernet interface and one for the wide area link, by entering the commands:

```
ADD IPX CIRC=1 INT=ETH0 NETW=401 ENCAP=802.3

ADD IPX CIRC=2 INT=PPP0 NETW=129
```

To repeat this procedure on the Remote Office router, defining one IPX circuit for the Ethernet interface and one for the wide area link, enter the commands:

```
ADD IPX CIRC=1 INT=ETH0 NETW=12 ENCAP=802.3

ADD IPX CIRC=2 INT=PPP0 NETW=129
```

The routers are now configured for IPX and can exchange routes and service information.

3. Test the Configuration

To examine the route table and service table on each router, enter the commands:

```
SHOW IPX ROUTE
SHOW IPX SERVICE
```

The route table will contain paths from each Novell device which advertises routes, for example file servers and routers. The service table lists all the services, such as file services and print services, that devices are advertising.

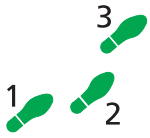
The actual contents of the route table varies with the number and type of file servers present on the network. A route from each router to the other, and all services shown as local (i.e. via eth0) on one router, should also be visible on the other router, via the PPP link.

Test that a workstation on the Remote Office LAN can login to the file server on the Head Office LAN.

4. Save the Configuration

Save the new dynamic configuration as a script, by entering the command:

```
CREATE CONFIG=IPXCONF.SCP
```



To add an IPX circuit over a VLAN

1. Define the IPX interface name

To create IPX circuit 1 with the Novell network number 129 over the admin VLAN, enter the command:

```
ADD IPX CIRC=1 INTERFACE=vlan11 NETWORK=129 ENCAP=802.3
```

2. Show the configuration

Show the new configuration by entering the command:

```
SHOW IPX CIRCUIT
```

The display should look like that shown in Figure 8 on page 79.

Figure 8: Example output from the SHOW IPX CIRCUIT command.

```
IPX CIRCUIT information

Name ........................ Circuit 1
Status ...................... enabled
Interface ................... vlan11   (802.3)
Network number .............. c0e7230f
Station number .............. 0000cd000d26
Link state .................. up
Cost in Novell ticks ......... 1
Type20 packets allowed ....... no
On demand ................... no

Spoofing information
Keep alive spoofing ......... no
SPX watch dog spoofing ....... no
On SPX connection failure .... UPLINK
On end of SPX spoofing ....... UPLINK

RIP broadcast information
Change broadcasts ............ yes
General broadcasts ........... yes
General broadcast interval ... 60 seconds
Maximum age .................. 180 seconds

SAP broadcast information
Change broadcasts ............ yes
General broadcasts ........... yes
General broadcast interval ... 60 seconds
Maximum age .................. 180 seconds

Filter information
Filters ..................... none
```

To interpret output from the SHOW IPX CIRCUIT command see the *Novell IPX* chapter in the *AR400 Series Router Software Reference*.

Configuring IPX Dial-on-Demand

This example (Figure 9 on page 80) illustrates how to set up the router to provide a wide area internet based on Novell's IPX routing protocol with dial-on-demand access. In this scenario, a PC at a remote site periodically accesses the Novell file server at a central site to read Email, transfer files or print documents on a laser printer. The two sites are connected by a PPP link over a wide area link—either a dedicated leased line or an ISDN call.

Figure 9: Example configuration for an IPX dial-on-demand network.

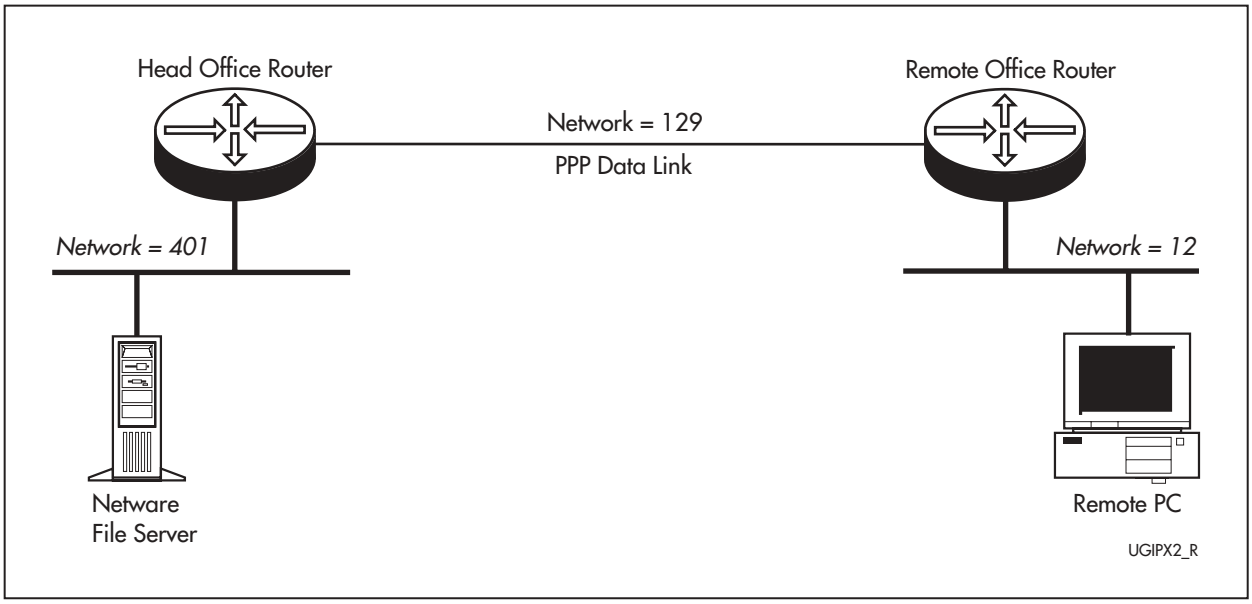
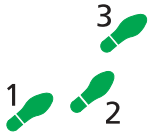


Figure 10: Example configuration parameters for IPX dial-on-demand.

Parameter	Head Office Router	Remote Office Router
Ethernet interface	eth0	eth0
Ethernet encapsulation	802.3	802.3
Novell network number for Ethernet	401	12
IPX circuit over Ethernet	1	1
PPP interface	ppp0	ppp0
Novell network number for PPP	129	129
IPX circuit over PPP	2	2



To configure IPX dial-on-demand follow these steps

If the PPP link uses an ISDN call configured as a dial-on-demand link (see "*Configuring ISDN Dial on Demand*" on page 60), then you can configure IPX for IPX dial-on-demand services.

The following steps are required:

1. Clear the previous IPX configuration.
2. Enable IPX.
3. Define the IPX circuits.
4. Save the configuration.

1. Clear previous IPX configuration

To purge the IPX static database to clear an preexisting IPX configuration enter the command:

```
PURGE IPX
```

2. Enable IPX

To enable the IPX routing software on each router, enter the command:

```
ENABLE IPX
```

3. **Define IPX circuits**

   On the Head Office router define two IPX circuits, one for the Ethernet interface and one for the wide area link. To configure the wide area link as a demand link and enable RIP and SAP change broadcasts, enter the commands:

   ```
   ADD IPX CIRC=1 INT=ETH0 NETW=401 ENCAP=802.3
   ADD IPX CIRC=2 INT=PPP0 NETW=129 DEMAND=ON
   SET IPX CIRC=2 RIPCHANGE=YES SAPCHANGE=YES
   ```

   Repeat this procedure on the Remote Office router, defining one IPX circuit for the Ethernet interface and one for the wide area link. To configure the wide area link as a demand link and enable RIP and SAP change broadcasts, enter the commands:

   ```
   ADD IPX CIRC=1 INT=ETH0 NETW=12 ENCAP=802.3
   ADD IPX CIRC=2 INT=PPP0 NETW=129 DEMAND=ON
   SET IPX CIRC=2 RIPCHANGE=YES SAPCHANGE=YES
   ```

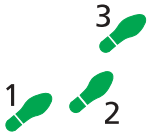
   The routers are now configured for IPX dial-on-demand and can exchange routes and service information.

4. **Save configuration**

   Save the new dynamic configuration as a script, by entering the command:

   ```
   CREATE CONFIG=IPXDOD.SCP
   ```

The link is activated (the ISDN call is connected) whenever data is waiting to transmit over the wide area link, and deactivated when no data is transmitted over the link for a period of time. The link is also activated whenever there is a change of route or service information, to allow the exchange of RIP and SAP updates. To improve performance, you can configure RIP and SAP filters on the Head Office router to limit the number and size of broadcasts which activate the ISDN call.



To configure RIP and SAP filters, follow these steps on the Head Office router only:

1. **Create RIP filter**

   To create a RIP filter that only allows information about route changes to the file server's internal network (network number 7500) to be included in RIP broadcasts, enter the command:

   ```
   ADD IPX RIP=0 NET=7500 ACTION=INCLUDE
   ```

2. **Create SAP filter**

   To create a SAP filter that only allows information about the file services provided by the file server (named ACCOUNTS) to be included in SAP broadcasts, enter the command:

   ```
   ADD IPX SAP=0 SERVICE=ACCOUNTS TYPE=FILE ACTION=INCLUDE
   ```

3. **Associate RIP and SAP filters with IPX circuit**

   To associate the RIP and SAP filters with the IPX circuit over the PPP link, enter the command:

   ```
   SET IPX CIRC=2 RIPCHANGE=YES SAPCHANGE=YES OUTRIP=0
       OUTSAP=0
   ```

4. Save configuration

To save the new dynamic configuration as a script, enter the command:

```
CREATE CONFIG=IPXFILT.SCP
```

AppleTalk

The AppleTalk network architecture provides internetworking of Macintosh computers and other peripheral devices using LocalTalk media. AppleTalk allows seamless access to network services such as file servers and printers from the Macintosh desktop environment. The open nature of the architecture has enabled the AppleTalk network system to extended support to other media types (for example EtherTalk for Ethernet media), and a mixture of both Apple and non-Apple network devices on the same AppleTalk network.

To create an AppleTalk port (interface) associated with the vlan11, enter the command:

```
ADD APPLE PORT INTERFACE=vlan11
```

To display information about the ports configured for AppleTalk (Figure 11 on page 82), enter the command:

```
SHOW APPLE PORT
```

Figure 11: Example output from the SHOW APPLE PORT command.

```
Appletalk Port Details
-----------------------------------
  Port Number ............. 1
  Interface ............... vlan11
  ifIndex ................. 1
  Node ID ................. 217
  Network Number .......... 22
  Network Range Start ..... 22
  Network Range End ....... 22
  State ................... ACTIVE
  Seed .................... NO
  Seed Network Start ...... 0
  Seed Network End ........ 0
  Hint .................... YES
  Hint Node ID ............ 179
  Hint Network ............ 22
  Default Zone ............ -

  Zone List is Empty
-----------------------------------
```

To interpret output from the SHOW APPLE PORT command see the *AppleTalk* chapter in the *AR400 Series Router Software Reference*.

Routing Information Protocol (RIP)

The Routing Information Protocol (RIP) is a distance vector protocol that is part of the TCP/IP protocol suite used to exchange routing information between routers. RIP determines a route based on the smallest hop count between source and destination.

Routing protocols such as RIPv1 and RIPv2 can be enabled on a VLAN. To enable RIPv2 on the admin VLAN, enter the command:

```
ADD IP RIP INTERFACE=vlan11 SEND=RIP2 RECEIVE=BOTH
```

To display information about RIP (Figure 12 on page 83), enter the command:

```
SHOW IP RIP
```

Figure 12: Example output from the SHOW IP RIP command.

```
Interface  Circuit/DLCI    IP Address     Send  Receive  Demand  Auth  Password
-------------------------------------------------------------------------------
vlan11     -               -              RIP2  BOTH     NO      NO
ppp0       -               172.16.249.34  RIP1  RIP2     YES     PASS  ********
-------------------------------------------------------------------------------
```

To interpret output from the SHOW IP RIP command see the *Internet Protocol (IP)* chapter in the *AR400 Series Router Software Reference*.

Resource Reservation Protocol (RSVP)

The Resource Reservation Protocol (RSVP) is a signalling protocol designed to reserve bandwidth for realtime transmission. RSVP is not a traffic delivery protocol or a routing protocol. RSVP does not deliver the application's traffic to its destination or manage the routing of the data packets; this is left to existing transport and routing protocols.

RSVP enables the receiver of a traffic flow to make the resource reservations necessary to ensure that the receiver obtains the desired Quality of Service (QoS) for the traffic flow.

RSVP is disabled by default. To enable RSVP, enter the command:

```
ENABLE RSVP
```

Each IP interface that is to receive and process RSVP messages and accept reservation requests must be enabled. To enable RSVP on the admin VLAN, enter the command:

```
ENABLE RSVP INTERFACE=vlan11
```

To display information about the interfaces enabled for RSVP (Figure 13 on page 84), enter the command:

```
SHOW RSVP INTERFACE
```

Figure 13: Example output from the SHOW RSVP INTERFACE command.

```
RSVP Interfaces
                    Maximum       Reserved       No. Of
Interface  Enabled  Bandwidth(%)  Bandwidth(%)   Reservations  Debug     Encap
-------------------------------------------------------------------------------
Dynamic      No        75             0              0         None      RAW
vlan11       Yes       75             0              1         None      RAW
ppp0         Yes       75             0              0         None      RAW
-------------------------------------------------------------------------------
```

To interpret output from the SHOW RSVP INTERFACE command see the *Resource Reservation Protocol (RSVP)* chapter in the *AR400 Series Router Software Reference*.

OSPF

Open Shortest Path First (OSPF) is an Internal Gateway Routing Protocol, based on Shortest Path First (SPF) or link-state technology. OSPF is a routing protocol that determines the best path for routing IP traffic over a TCP/IP network.

These features are supported by OSPF:

- Authentication of routing updates.
- Tagging of externally-derived routes.
- Fast response to topology changes with low overhead.
- Load sharing over meshed links.

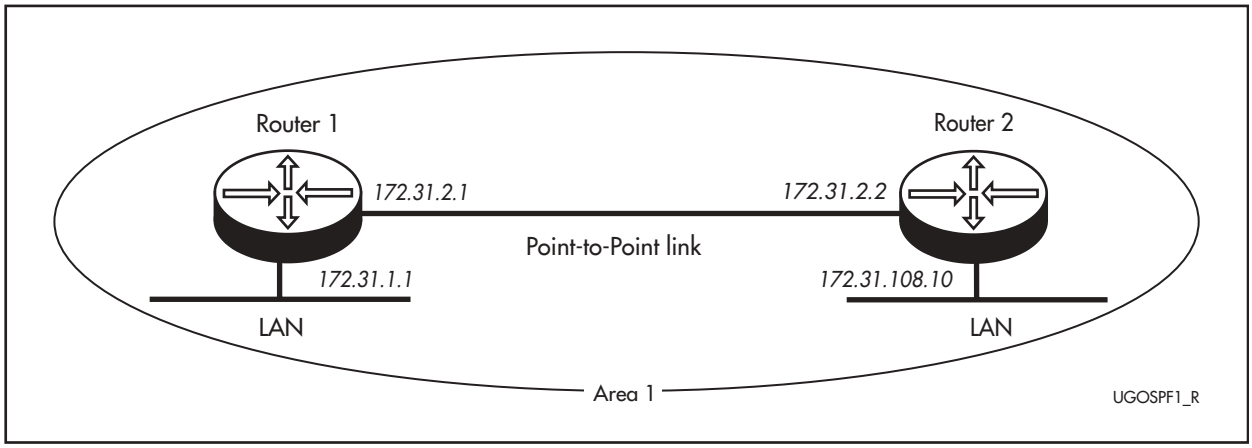
OSPF supports three types of physical networks—point-to-point, broadcast and non-broadcast.

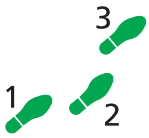
When using OSPF to route an IP packet, the router looks up the routing table entry which best matches the destination of the packet. This routing table entry contains the interface and nexthop router to forward the IP packet to its destination. The routing table entry that best matches the destination is determined first by the path type, then the longest (most specific) network mask. At this point there may still be multiple routing entries to the destination; if so then equi-cost multi-path routes exist to the destination. Such equi-cost routes are appropriately used to share the load to the destination.

Configuring a Basic OSPF Network

This example (Figure 14 on page 85) is a simple network of two routers connected together, each with its own local area network. The routers all belong to a single class B network 172.31.0.0, which has further been subnetted using the subnet mask 255.255.255.0.

Figure 14: .A basic OSPF network with an addressless PPP link.





To configure a basic OSPF network follow these steps

The following steps are required:

1. Configure the PPP and Ethernet interfaces on router 1.
2. Configure router 1 as an OSPF router.
3. Configure the PPP and Ethernet interfaces on router 2.
4. Configure router 2 as an OSPF router.

1. Configure the PPP and Ethernet interfaces on router 1.

To create IP interfaces to use the PPP and Ethernet interfaces, and assign an OSPF metric to each IP interface, enter the command:

```
CREATE PPP=0 OVER=SYN0
ENABLE IP
ADD IP INTERFACE=PPP0 IP=172.31.2.1 MASK=255.255.255.0
   OSPFMETRIC=1
ADD IP INTERFACE=ETH0 IP=172.31.1.1 MASK=255.255.255.0
   OSPFMETRIC=1
```

2. Configure router 1 as an OSPF router.

To create an OSPF area, assign the IP interfaces to the area, and configure OSPF routing parameters, enter the command:

```
ENABLE OSPF
ADD OSPF AREA=0.0.0.1 AUTHENTICATION=PASSWORD
ADD OSPF RANGE=172.31.0.0 AREA=0.0.0.1 MASK=255.255.0.0
ADD OSPF INTERFACE=ETH0 AREA=0.0.0.1 PASSWORD=asecret
ADD OSPF INTERFACE=PPP0 AREA=0.0.0.1 PASSWORD=bsecret
```

3. Configure the PPP and Ethernet interfaces on router 2.

To create IP interfaces to use the PPP and Ethernet interfaces, and assign an OSPF metric to each IP interface, enter the command:

```
CREATE PPP=0 OVER=SYN0
ENABLE IP
ADD IP INTERFACE=PPP0 IP=172.31.2.2 MASK=255.255.255.0
   OSPFMETRIC=1
ADD IP INTERFACE=ETH0 IP=172.31.108.10 MASK=255.255.255.0
   OSPFMETRIC=1
```

4. Configure router 2 as an OSPF router.

To create an OSPF area, assign the IP interfaces to the area, and configure OSPF routing parameters, enter the command:

```
ENABLE OSPF
ADD OSPF AREA=0.0.0.1 AUTHENTICATION=PASSWORD
ADD OSPF RANGE=172.31.0.0 AREA=0.0.0.1 MASK=255.255.0.0
ADD OSPF INTERFACE=ETH0 AREA=0.0.0.1 PASSWORD=csecret
ADD OSPF INTERFACE=PPP0 AREA=0.0.0.1 PASSWORD=bsecret
```

For more information about configuring OSPF, see the *Open Shortest Path First (OSPF)* chapter in the *AR400 Series Router Software Reference.*

Chapter 6

Maintenance and Troubleshooting

This Chapter

If you are familiar with networking and router operations, you may be able to diagnose and solve some problems yourself.

This chapter gives tips on how to:

- start your router (see "*How the Router Starts Up*" on page 88).
- avoid problems (see "*How to Avoid Problems*" on page 89).
- reconfigure your router if you accidentally clear the FLASH memory (see "*What to do if you clear FLASH memory completely*" on page 90).
- troubleshoot ISDN connections (see "*What to do if ISDN Fails to Connect*" on page 91).
- troubleshoot a PPP link that disconnects (see "*What to do if the PPP Link Disconnects Regularly*" on page 92).
- reset passwords if they are lost (see "*What to do if Passwords are Lost*" on page 92).
- gather information from your router that support personnel need to provide accurate support tailored to your situation (see *"Getting the Most Out of Technical Support*" on page 93).
- restart the router at any time with no configuration (see "*Resetting Router Defaults*" on page 94).
- check whether there is a connection between the router and another routing interface in the network (see "*Checking Connections Using PING*" on page 94).
- troubleshoot if no routes exists to the remote router (see "*Troubleshooting IP Configurations*" on page 95 and "*Troubleshooting IPX Configurations*" on page 97).
- troubleshoot problems with DHCP IP addresses if the router is acting as a client or as a server (see "*Troubleshooting DHCP IP Addresses*" on page 96)
- examine the route that packets pass between two systems running the IP protocol (see "*Using Trace Route for IP Traffic*" on page 99).

Information gained from the LEDs on the front panel of the router is described in the *AR Series Router Hardware Reference*.

How the Router Starts Up

The sequence of operations that the router performs when it boots are:

1. Perform startup self tests.
2. Perform the install override option.
3. Load the EPROM release as the INSTALL boot.
4. Inspect and check INSTALL information.
5. Load the required EPROM or FLASH release as the main boot.
6. Start the router.
7. Execute the boot script, if one has been configured.

If a terminal is connected to *asyn0*, a series of status and progress messages similar to those shown in Figure 15 on page 88 are displayed during the startup process.

Figure 15: router startup messages.

```
INFO: Self tests beginning.
INFO: RAM test beginning.
PASS: RAM test, 4096k bytes found.
INFO: BBR tests beginning.
PASS: BBR test, 128k bytes found.
PASS: BBR test. Battery OK.
INFO: Self tests complete
INFO: Downloading router software.
Force EPROM download (Y) ?
INFO: Initial download succeeded
INFO: Executing configuration script <boot.cfg>
INFO: Router startup complete

Manager >
```

The startup self tests check the basic operation of the router. If your router passes these tests the router should be able to at least proceed far enough to perform the load of the EPROM release and to start operating.

The install override option is designed to allow a mandatory router boot from the EPROM release. The message:

```
Force EPROM download (Y)?
```

is displayed on the terminal connected to *asyn0* and the router pauses. If you do not press a key within a few seconds, the startup process will continue and all steps in the sequence are executed. If the [Y], [S] or [Ctrl/D] key on the terminal are pressed immediately after the message is displayed, you can alter the router startup process (Table 14 on page 88).

Table 14: router startup sequence keystrokes.

Pressing key...	Forces the router to...
Y	Load the EPROM release, with no patch, and skip straight to step 6.
S	Start with the default configuration. Any boot script or NVS configuration is ignored.
N	Configure from NVS, ignoring any boot script.
[Ctrl/D]	Enter diagnostics mode.

When you start the router the EPROM release is always loaded first. The EPROM release contains all the code required to obtain and check the INSTALL information. This first boot is known as the INSTALL boot. The INSTALL information is inspected and the router is setup to perform another load. Even if the actual release required is the EPROM release, another load is always performed. At this point, if a patch load is required, it is also performed.

The router startup occurs immediately after the install override option, or after the INSTALL information check. The INSTALL information check performs a full startup of router software and initiates the normal operation of the router.

Finally, if there is a defined boot script, this script is executed.

How to Avoid Problems

If you perform the following procedures you may help reduce the likelihood and impact of some future router events.

Set system territory

Set the system territory to the country or region in which the router is connected to the network. Some protocols (for instance, ISDN) are implemented in differently in some countries. To ensure that the router uses variants that will work in the country your router is routing in, enter the command:

```
SET SYSTEM TERRITORY={AUSTRALIA|CHINA|EUROPE|JAPAN|KOREA|
    NEWZEALAND|USA}
```

Backup software files

Store a backup of the current router software. If the router software is accidentally cleared from the router's FLASH memory, you will need to reload the software release and patch files. If your access to the Internet is via the router, then you will need the files on your LAN. You may wish to keep a copy of the current software and patch files on a TFTP server on your network. You can download router software from the support site at *http://www.alliedtelesyn.co.nz/support/ar400*.

Backup configuration script

Store a backup of the latest configuration script, in case the configuration file on the router is accidentally deleted or damaged.

Backup router

If your network has many routers, you may wish to keep a backup router ready to replace any router that malfunctions. When you upgrade the software release or patch on the other routers in the network, upgrade the backup too. Store on it one current config script for each router in your network, so that when it is needed, you need only set the configuration file with which it boots to match the router it replaces.

Configure logging

The logging facility stores log messages for events with a specified severity in a log file. You can change the size of the log file, and the kind of messages recorded. You can configure the router to output log messages in several ways, including to a remote router with a specified IP address, or as an email to a particular email address. The router can also receive log messages from another router. Set the Logging Facility to log and forward the log messages you need to monitor your network (see the *Logging Facility* chapter in the *AR400 Series Router Software Reference*). Inspect the log file from time to time, and if difficulties arise.

Configure Firewall

Use the Firewall to protect your network from several kinds of unwanted traffic or deliberate attacks (see the *Firewall* chapter in the *AR400 Series Router Software Reference*, special feature licence required).

FLASH compaction

If the FLASH memory gets filled beyond a certain level, it will automatically activate FLASH compaction to recover any space that is made available from deleted files. You can also activate FLASH compaction manually if required.

While FLASH is compacting, do not restart the router or use any commands that affect the FLASH file subsystem. Do not restart the router, or create, edit, load, rename or delete any files until a message confirms that FLASH file compaction is completed. Interrupting flash compaction may result in damage to files. Damaged files are likely to prevent the router from operating correctly.

Watch for software updates

From time to time patches may be released to improve the function of your router software, and new software releases make new features available. Watch for patches and new software releases on the support site at http://www.alliedtelesyn.co.nz/support/ar400.

What to do if you clear FLASH memory completely

DO NOT clear the FLASH memory completely. The software release files are stored in FLASH, and clearing it would leave no software to run the router.

If you accidentally do this, you will need to:

1. **Boot with default configuration.**

   Reboot the router from a terminal connected the asynchronous terminal port (not Telnet). Use the install override to run the default configuration (see "*How the Router Starts Up*" on page 88).

2. **Log in.**

   Log in to the router using the default password *friend* for the *manager* account.

3. **Put current software release on server.**

   Make sure you have the current software release and patch files on a server connected to the router by the switch port or Ethernet port. Current software release and patch files are downloaded from the support site at http://www.alliedtelesyn.co.nz/support/ar400.

4. **Assign an IP address.**

   Assign an IP address to the router interface over which the software files are downloaded (see "*Assigning an IP Address*" on page 20).

5. **Load software files onto router.**

   Load the required software and patch onto the router (see "*Loading and Uploading Files*" on page 30).

6. **Set the install information.**

   Set the router to use the software installed (see "*Upgrading Router Software*" on page 34).

7. **Reconfigure the router.**

   If you have a copy of the recent configuration file stored on your network, you can download this onto the router too. Otherwise you will need to re-enter all configuration.

While FLASH is compacting, do not restart the router or use any commands that affect the FLASH file subsystem. Do not restart the router, or create, edit, load, rename or delete any files until a message confirms that FLASH file compaction is completed. Interrupting flash compaction may result in damage to files. Damaged files are likely to prevent the router from operating correctly.

If you accidentally restart the router, or use any commands that affect the FLASH file subsystem, contact your authorised distributor or reseller. You may have to return the router to the factory.

What to do if ISDN Fails to Connect

Make sure the system territory is set to the country or region in which your router is located. This is important because different countries use variations on the ISDN protocols, and the system territory setting on the router ensures that the router behaviour is compatible with the ISDN network.

```
SET SYSTEM TERRITORY={AUSTRALIA|CHINA|EUROPE|JAPAN|KOREA|
    NEWZEALAND|USA}
```

Use PING ("*Checking Connections Using PING*" on page 94) to determine which link is failing.

- PING the remote router. If this succeeds, the ISDN network is functioning, and any difficulties are in a higher layer protocol. If this fails, PING all intermediate IP interfaces.

- PING the IP address at the local router's interface to the Network Terminator (NT). If this fails, check the IP configuration on your router.
- PING the Network Terminator (NT) interface to the router at the local premises. If this fails, check the physical connection between the router and the NT.
- PING the Network Terminator (NT) interface to the ISDN network at the local premises. If this fails, the NT may be faulty.
- PING the Network Terminator (NT) interface to the ISDN network at the remote premises, if known. If this succeeds, the ISDN network is functioning. If this fails, the ISDN network is faulty. Contact your ISDN service provider, and tell them which interfaces you have succeeded and failed to PING.
- PING the Network Terminator (NT) interface to the router at the remote premises, if known. If this fails, the problem is in the NT at the remote site.
- PING the Network Terminator (NT) interface to the router at the remote premises, if known. If this fails, then the problem is in the NT at the remote premises.

What to do if the PPP Link Disconnects Regularly

If the device at the other end of the PPP link is not an ATR router or switch but is supplied by another vendor turn LQR (Link Quality Reporting) off on PPP links (LQR=OFF) and instead use LCP Echo Request and Echo Reply messages to determine link quality (ECHO=ON). Enter the command:

```
SET PPP=ppp-interface ECHO=ON LQR=OFF
```

What to do if Passwords are Lost

If a user forgets their password, to reset the password from an account with MANAGER privilege, enter the command:

```
SET USER=login-name PASSWORD=password
```

You can reset passwords for accounts with MANAGER privilege with the same command, provided the manager can login to at least one account with MANAGER privilege.

If you require further assistance contact your authorised distributor or reseller.

Getting the Most Out of Technical Support

For online support for your router, see our on-line support page at http://www.alliedtelesyn.co.nz/support/ar400.

If you require further assistance, contact your authorised distributor or reseller. Gather as much of the following information from your router and network as you can. This gives the support personnel as much information as possible to diagnose and solve your problem. They may ask you to send the information to them by email.

Gather this information:

- Your name, organisation and contact details.
- What is the make and model of your router? Are any expansion options installed? For instance, AR410 and AT-AR020 PRI E1/T1 PIC. Enter the command:

  ```
  SHOW SYSTEM
  ```

- Which software release and patch files is your router running? For example, `52-231.rez`, `52231-01.paz`. Enter the command:

  ```
  SHOW INSTALL
  ```

- What software configuration is currently running? Enter the command:

  ```
  SHOW CONF DYN
  ```

- How is the router connected to your network? A diagram showing the physical configuration of the network your router is operating in may be useful.
- To get debugging output, enter the command:

  ```
  SHOW DEBUG
  ```

- Depending on the problem, the support personnel may also ask you for the output from the following commands (see the *Monitoring and Fault Diagnosis* section in the *Operations* chapter, *AR400 Series Router Software Reference*):

  ```
  SHOW EXCEPTION
  SHOW STARTUP
  SHOW LOG
  SHOW CPU
  SHOW BUFFER
  ```

Resetting Router Defaults

To restart the router at any time with no configuration, enter the command:

```
RESTART ROUTER CONFIG=NONE
```

If `boot.cfg` has changed, to set it back to the default configuration by saving the default dynamic configuration to the `boot.cfg` file, enter the command:

```
CREATE CONFIG=boot.cfg
```

To set the router to restart with the boot configuration file, enter the command:

```
SET CONFIG=boot.cfg
```

DO NOT clear the FLASH memory completely. The software release files are stored in FLASH, and clearing it would leave no software to run the router.

Checking Connections Using PING

If an aspect of the router's configuration dependent on access to a server functions incorrectly, PINGing the server from the router, and the router from the server, is a useful first step in diagnosis.

You can use PING (Packet Internet Groper) to check whether there is a connection between the router and another routing interface in the network. Use the router's extended PING command over IPv4, IPv6, IPX, AppleTalk, and OSI network protocols. PING sends echo request packets in the chosen format, and displays responses at the terminal. Enter the command:

```
PING [{[IPADDRESS=]ipadd|[IPXADDRESS=]network:station|
    [APPLEADDRESS=]network.node|[OSIADDRESS=]nsap}]
    [LENGTH=number] [NUMBER={number|CONTINUOUS}]
    [PATTERN=hexnum]
    [{SIPADDRESS=ipadd|SIPXADDRESS=network:station|
    SAPPLEADDRESS=network.node|SOSIADDRESS=nsap}]
    [SCREENOUTPUT={YES|NO}] [TIMEOUT=number] [TOS=number]
```

To set PING defaults, enter the command:

```
SET PING [{[IPADDRESS=]ipadd|[IPXADDRESS=]network:station|
    [APPLEADDRESS=]network.node|[OSIADDRESS=]nsap}]
    [LENGTH=number] [NUMBER={number|CONTINUOUS}]
    [PATTERN=hexnum]
    [{SIPADDRESS=ipadd|SIPXADDRESS=network:station|SAPPLEADDR
    ESS=network.node|SOSIADDRESS=nsap}]
    [SCREENOUTPUT={YES|NO}] [TIMEOUT=number] [TOS=number]
```

To display the default PING settings and summary information, enter the command:

```
SHOW PING
```

The stop a PING that is in progress, enter the command:

```
STOP PING
```

If you can PING the end destination, then the physical and layer 2 links are functioning, and any difficulties are in the network or higher layers.

If PING to the end destination fails, PING intermediate network addresses. If you can successfully PING some network addresses, and not others, you can deduce which link in the network is down.

Note that if Network Address Translation (NAT) is configured on the remote router, PINGing devices connected to it may give misleading information.

For more information about using PING, see the *Internet Protocol (IP)* chapter in the *AR400 Series Router Software Reference*.

Troubleshooting IP Configurations

No Route Exists to the Remote Router

1. **Wait for RIP update**

   Wait for at least one minute to ensure that a RIP update has been received (See "*Routing Information Protocol (RIP)*" on page 83).

2. **Try using Telnet to access the remote router.**

   To Telnet from the local router to the remote router, and from the remote router to the local router, enter the command:

   ```
   TELNET {ipadd|ipv6add|host}
   ```

3. **Check PPP link**

   To check that the PPP link is OPENED for both LCP and IP, enter the command:

   ```
   SHOW PPP
   ```

   The display should look like that shown in Figure 16 on page 95. For more information on how to check the PPP link see "*Point-to-Point Protocol (PPP)*" on page 5-1 in the *Point-to-Point Protocol (PPP)* chapter, *AR400 Series Router Software Reference*.

Figure 16: Example output from the SHOW PPP command for a basic TCP/IP network.

```
Name            Enabled  ifIndex  Over                  CP            State
-------------------------------------------------------------------------
ppp0              YES      04                           IPCP          OPENED
                                    isdn-roho            LCP           OPENED
-------------------------------------------------------------------------
```

To interpret output from the SHOW PPP command see the *Point-to Point (PPP)* chapter in the *AR400 Series Router Software Reference*.

4. **Restart IP**

   To try restarting the IP routing software (a warm restart), enter the command:

   ```
   RESET IP
   ```

5. **Contact your authorised distributor or reseller for assistance**

   If the route still does not appear, contact your authorised distributor or reseller for assistance.

Telnet Fails

1. **If Telnet to router fails**

   Check that the IP address you used matches the one assigned to the router.

   To check that RIP is configured correctly, enter the command:

   ```
   SHOW IP RIP
   ```

   To check that the IP Telnet server is enabled on each router, enter the command.

   ```
   SHOW IP
   ```

   If the Telnet server is disabled, enable the Telnet server with the command:

   ```
   ENABLE TELNETSERVER
   ```

2. **If Telnet to host fails**

   If Telnet into a host on the remote LAN fails, but works into the remote router, check that the IP address you are using is correct. To check that both routers are gateways, not servers, enter the command:

   ```
   SHOW IP
   ```

   The "IP Packet Forwarding" field in the output should be set to "Enabled". Refer to the documentation for the host TCP/IP software for more information about configuring a gateway.

   The host's TCP/IP software should be configured to use the Head Office router as its gateway. Refer to the documentation for the host TCP/IP software for more information about configuring a gateway.

3. **Contact your authorised distributor or reseller for assistance**

   If problems persist, contact your authorised distributor or reseller for assistance.

Troubleshooting DHCP IP Addresses

Your router is acting as a DHCP client

If your router is acting as a DHCP client the router should receive its IP address dynamically. If your router is not receiving an IP address, check that the domain name and host name are correct.

Your router is acting as a DHCP server

If your router is not assigning IP addresses to a host, or hosts, on the subnet perform this procedure:

1. Reboot the host machine, to force it to re-request IP settings.
2. Check the host's TCP/IP settings.

   In Microsoft® Windows™ 95/98, click **Settings** → **Control Panel** → **Network**. Select **TCP/IP** and click **Properties**. Click **Obtain an IP address automatically**.

In Microsoft® Windows™ 2000, click **Settings** → **Control Panel** → **Network and Dial-up Connections** → **Local Area Connection** → **Properties**. Select **Internet connection (TCP/IP)** and click **Properties**. Click **Obtain an IP address automatically**.

3. Check that the DHCP server has a large enough range of addresses. To assign a range, enter the command:

```
CREATE DHCP RANGE
```

Troubleshooting IPX Configurations

No Routes are Visible to the Remote Router

1. Check the PPP link

To check that the PPP link is active, enter the command:

```
SHOW PPP
```

The display should look like that shown in Figure 17 on page 97. The state of the IPX control protocol (IPXCP) should be "OPENED". If not, then the fault lies with the connection between the two routers, or the PPP configuration at either end of the link.

Figure 17: Example output from the SHOW PPP command for a basic Novell IPX network.

```
Name            Enabled  ifIndex  Over                  CP           State
-------------------------------------------------------------------------
ppp0              YES      04                           IPXCP        OPENED
                                   isdn-roho             LCP          OPENED
-------------------------------------------------------------------------
```

To interpret output from the SHOW PPP command see the *Point-to Point (PPP)* chapter in the *AR400 Series Router Software Reference*.

2. Check IPX circuit configuration

To check that the IPX circuits are correctly configured on each router repeat steps 1 through 3 above, or enter the command:

```
SHOW IPX CIRCUIT
```

Check that there are two circuits, and for each circuit check that the circuit is enabled, uses the correct interface and encapsulation (for Ethernet interfaces), the network number is correct and "On demand" is set to "no". If not, then repeat steps 1 through 3.

3. Contact your authorised distributor or reseller for assistance

If you still have no visible routes to the remote router, contact your authorised distributor or reseller for assistance.

Local Workstations Can Not Access Remote Servers

A number of different events can cause this problem. The following list of events gives the most common:

1. **Move workstation to server LAN**

   Check that when the workstation is moved to the same LAN as the file server, it is able to access the server. If not, the fault lies with the configuration of the workstation or file server. Check with your Novell network administrator.

2. **Check NET.CFG file**

   Take care with the workstation NET.CFG file. Always specify the encapsulation (frame) as different LAN card drivers use different default encapsulations.

3. **Check for file server on Remote Office router**

   Does the file server appear in the IPX service table of the Remote Office router? If the server does not appear in the table, its presence is not advertised to the local LAN. To check this, enter the command:

   ```
   SHOW IPX SERVICE
   ```

   This should produce a display like that shown in Figure 18 on page 98. The important point is that the file server must appear in the service table on the Remote Office router and there must be a route to the file server's internal network number. If there is, and it still does not work, contact your authorised distributor or reseller for assistance.

Figure 18: Example output from the SHOW IPX SERVICES command for a basic Novell IPX network

```
IPX services
Name                                                                  Age
  Address                      Server type           Circuit      Hops  Defined
------------------------------------------------------------------------------
ACCOUNTS                                                              0
  00007500:000000000001:0451   0004:Fileserver         1 (eth0)     1   SAP
ACCOUNTS                                                              0
  00007500:000000000001:8104   0107:RCconsole          1 (eth0)     1   SAP
TYPISTS                                                               0
  00000012:0080488018d8:0451   0004:FileServer         1 (ppp0)     2   SAP
------------------------------------------------------------------------------
```

   To interpret output from the SHOW IPX SEVICES command see the *Novell IPX* chapter in the *AR400 Series Router Software Reference*.

4. **Check route tables**

   To check the route tables on both routers, enter the command:

   ```
   SHOW IPX ROUTE
   ```

   Check for the presence of networks on the remote side of the wide area network. If the remote network is missing from the route table on either router, enter the command:

   ```
   RESET IPX
   ```

   which resets the IPX routing software and forces the routers to broadcast their routing and service tables.

Using Trace Route for IP Traffic

You can use trace route to discover the route that packets pass between two systems running the IP protocol. Trace route sends an initial UDP packets with the Time To Live (TTL) field in the IP header set starting at 1. The TTL field is increased by one for every subsequent packet sent until the destination is reached. Each hop along the path between two systems responds with a TTL exceeded packet and from this the path is determined.

To initiate a trace route, enter the command:

```
TRACE [[IPADDRESS=]ipadd] [MAXTTL=number] [MINTTL=number]
   [NUMBER=number] [PORT=port-number] [SCREENOUTPUT={YES|NO}]
   [SOURCE=ipadd] [TIMEOUT=number] [TOS=number]
```

Any parameters not specified use the defaults configured with a previous invocation of the command:

```
SET TRACE [[IPADDRESS=]ipadd] [MAXTTL=number] [MINTTL=number]
   [NUMBER=number] [PORT=port-number] [SCREENOUTPUT={YES|NO}]
   [SOURCE=ipadd] [TIMEOUT=number] [TOS=number]
```

As each response packet is received a message is displayed on the terminal device from which the command was entered and the details are recorded. To display the default configuration and summary information, enter the command:

```
SHOW TRACE
```

To halt a trace route that is in progress, enter the command:

```
STOP TRACE
```

For more information about trace route, see the *Internet Protocol (IP)* chapter in the *AR400 Series Router Software Reference*.

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